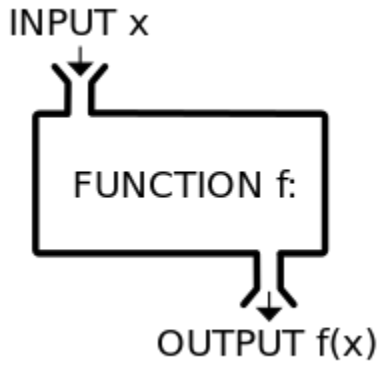
Linear Functions



Unit 3

Standards:

8.F.1 Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.

8.F.3 Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear.

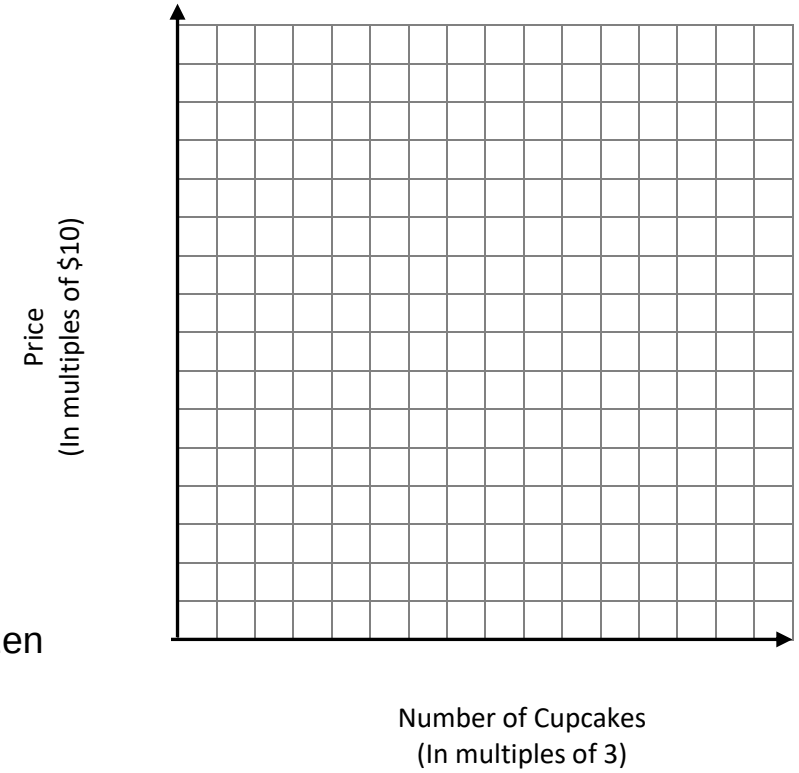
8.F.4 Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.

Name: _____ **Period:** _____

Lesson #31 Graphing Real Life Scenarios

1. A bakery sells 12 cupcakes for $30. Complete the table below and graph a line that represents the cost of any number of cupcakes.

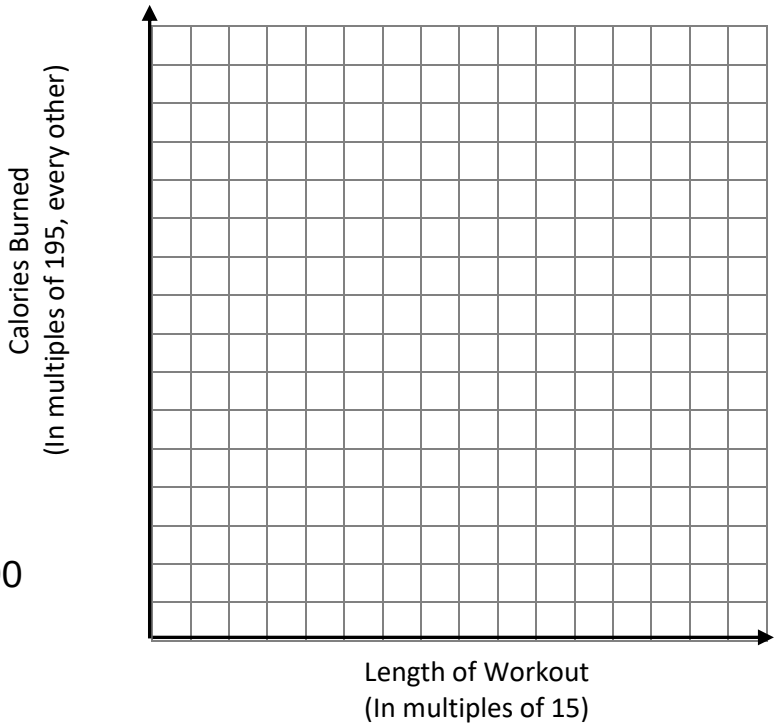
Number of Cupcakes	Cost
0	
6	
12	
24	
30	



How much will it cost to order 4 dozen cupcakes?

2. During a workout an average teenager burns 195 calories in 30 minutes. Complete the table below and graph a line that represents the number of calories burned for any length of workout time.

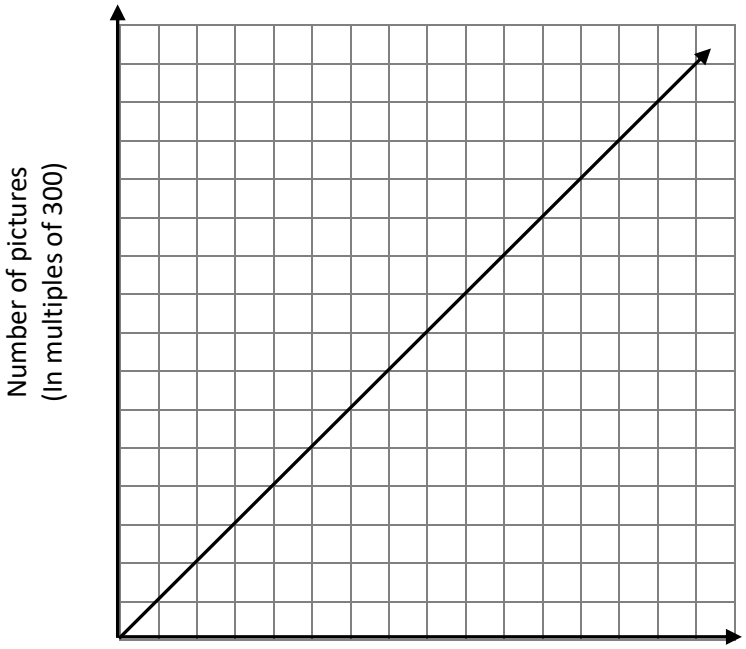
Length of workout (mins)	Calories Burned
0	
15	
30	
60	
120	



How many calories will be burned in 90 minutes?

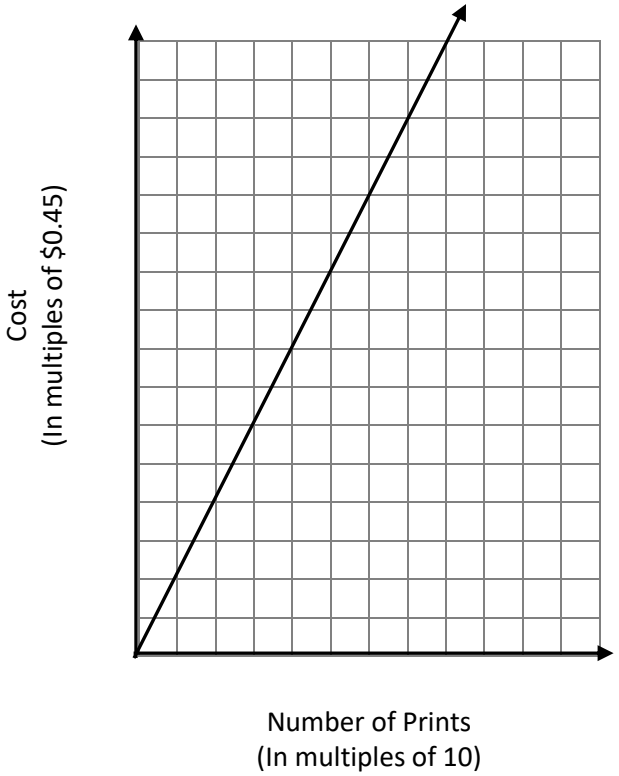
3. The graph below shows how many pictures a flash drive can store. Complete the table.

Number of Gigabytes n	Files stored
1	
	1500
	2400
5	
8	



4. The graph below shows how much a photo printing company charges for 4” by 6” inch prints. Complete the table.

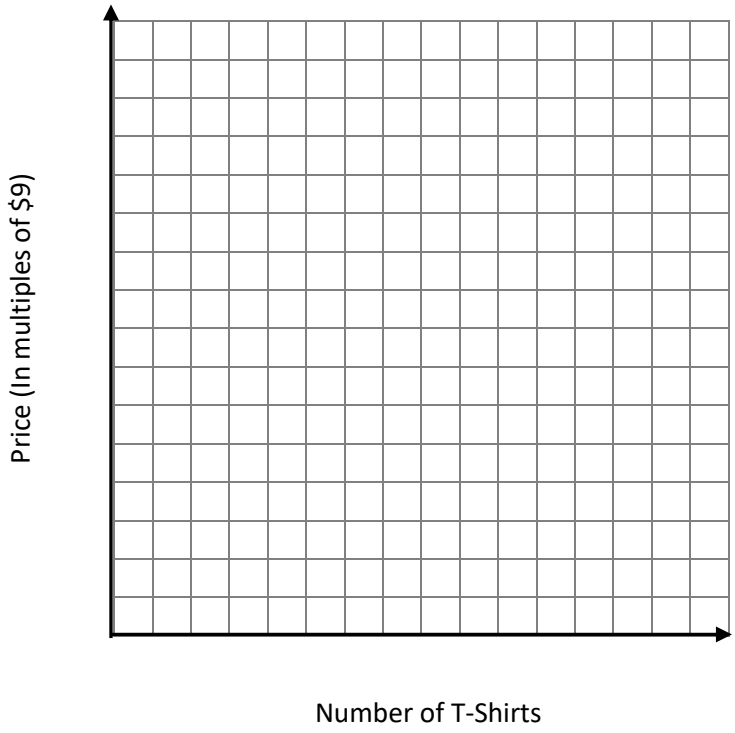
Number of Prints	Cost
20	
25	
	4.50
	7.20
100	9.00



Lesson #32 Real Life Graph Scenarios Cont'd

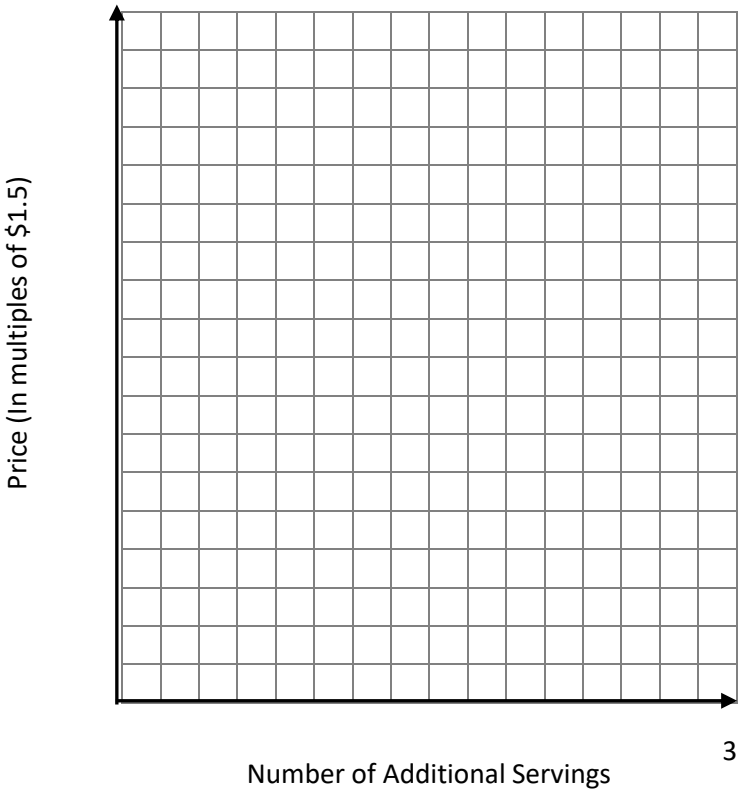
1. A t-shirt company charges a design fee of $18 for a pattern and then sells the shirts for $9 each. Complete the table and graph below.

Number of T-Shirts	Price
	18
4	
10	
	144



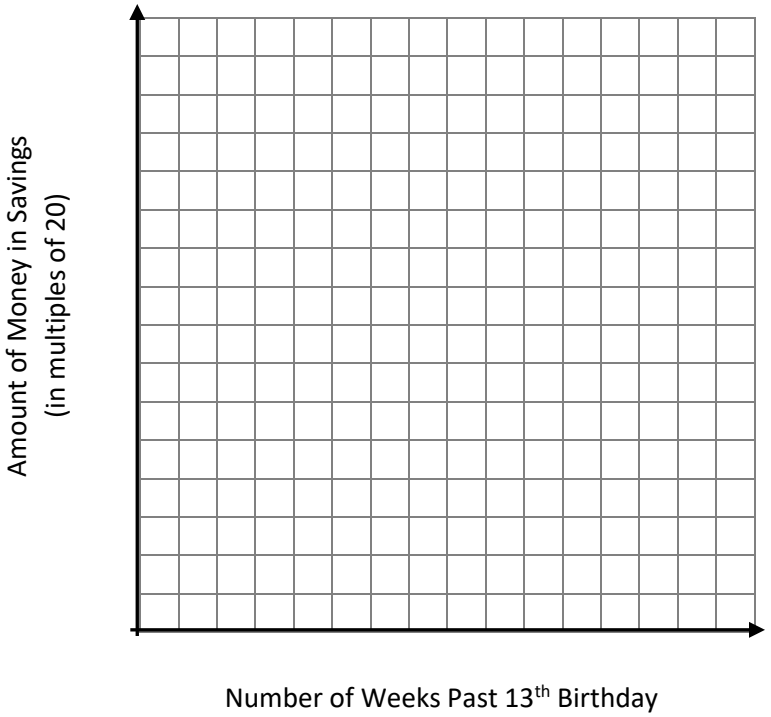
2. Mrs. Allison charges $27 for a basic cake that serves 12 people. A larger cake costs an additional $1.50 per serving. Complete the table and graph below.

Number of Additional Servings	Price
0	
	33
10	
	51



3. Louis received $100 in gifts for his thirteenth birthday. He plans to open a savings account with the money and add $20 per week. Complete the table and graph below.

Number of Weeks Past Birthday	Savings
	100
7	
	340
15	



4. How do the graphs of the scenarios we looked at today differ from the ones we saw yesterday and why do you think this is? Be specific.

_____

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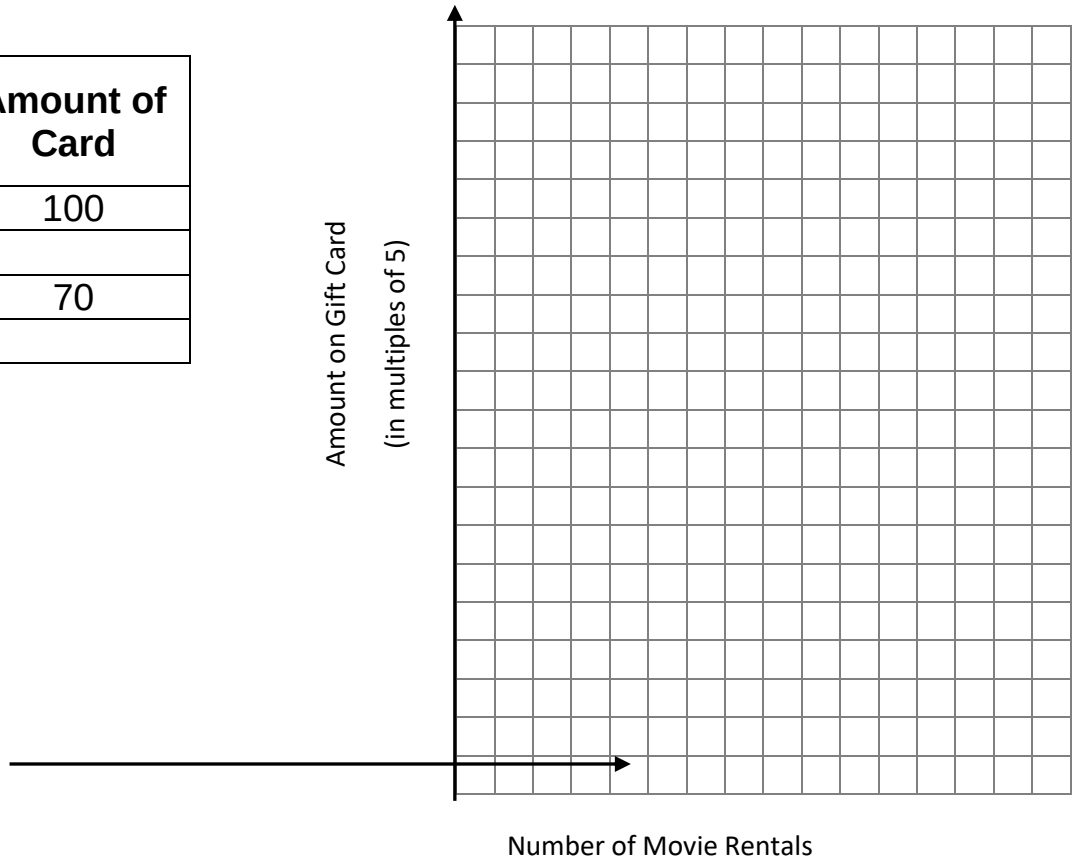
Lesson #33 Real Life Graph Scenarios Cont'd

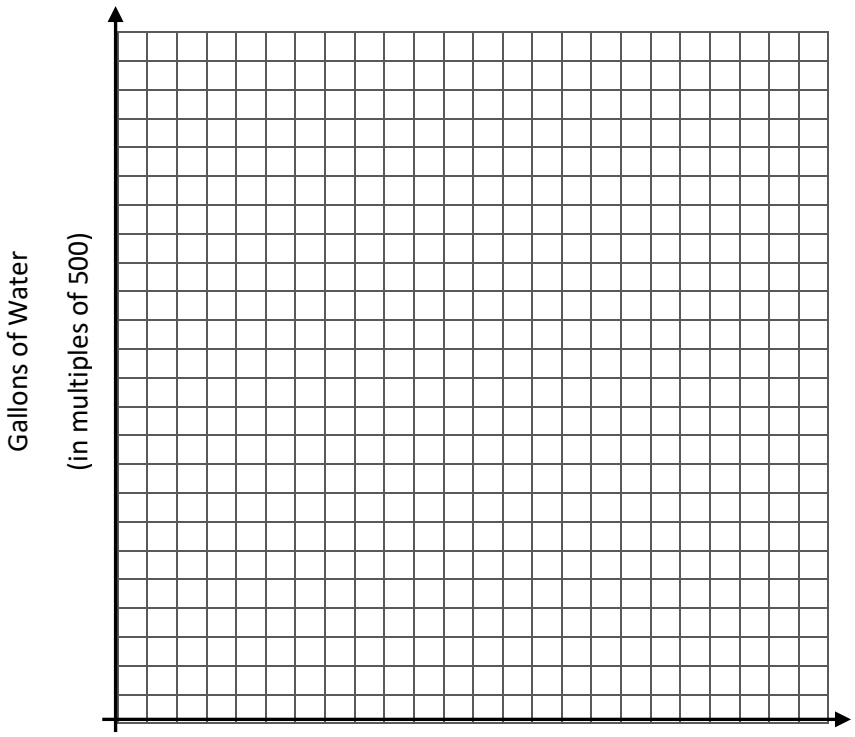
1. Michael received a $100 Blockbuster Gift card for his birthday. He rents movies for $2.50 each.

Number of Movie Rentals	Amount of Card
	100
6	
	70
40	



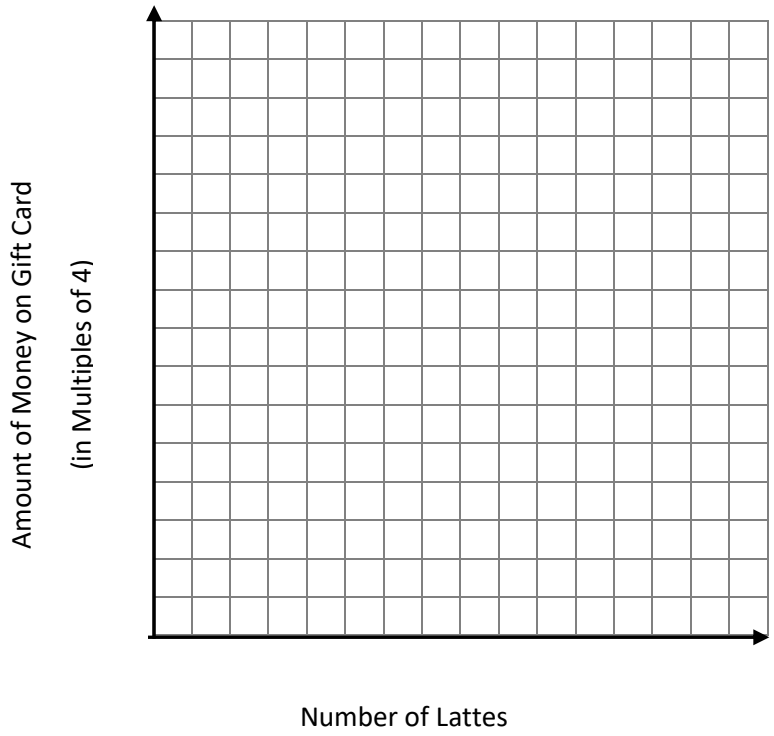
2. A pool holds 12,000 gallons of water and is emptying at a rate of 750 gallons per hour.

Number of Hours	Gallons of Water
	12000
4	
	4500
16	



3. Mrs. Keesler received a $60 Dunkin Donuts card from one of her students. She uses it only to purchase medium lattes that cost $3.00 each.

Number of Lattes	Amount on Gift Card
	60
4	
	12
15	



4. How do the graphs of the scenarios we looked at today differ from the ones we saw yesterday and the day before and why do you think this is? Be specific.

_____

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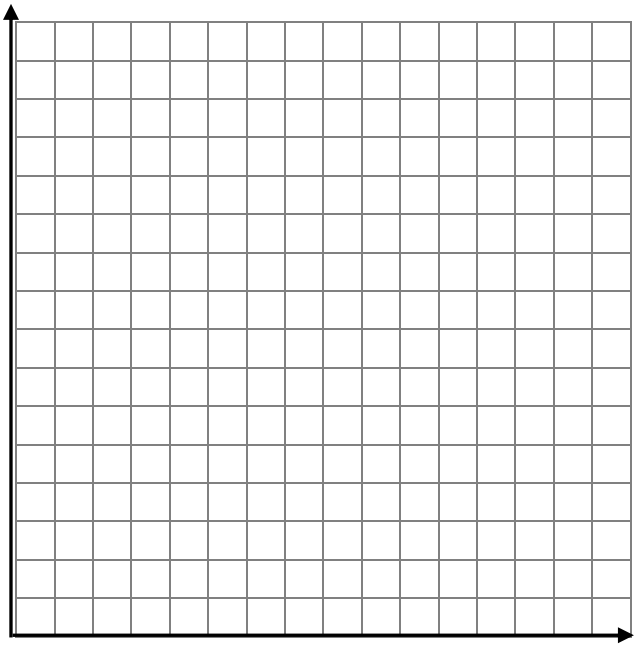
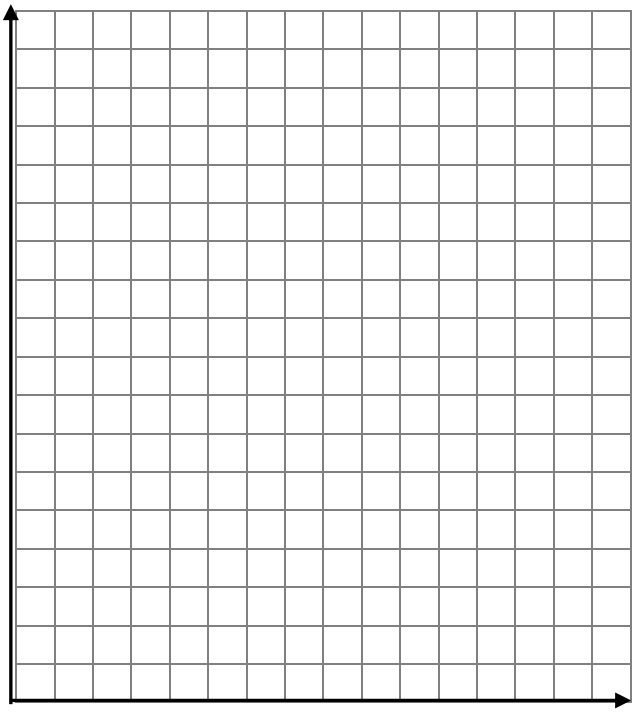
Lesson #34 Real Life Graph Scenarios Cont'd

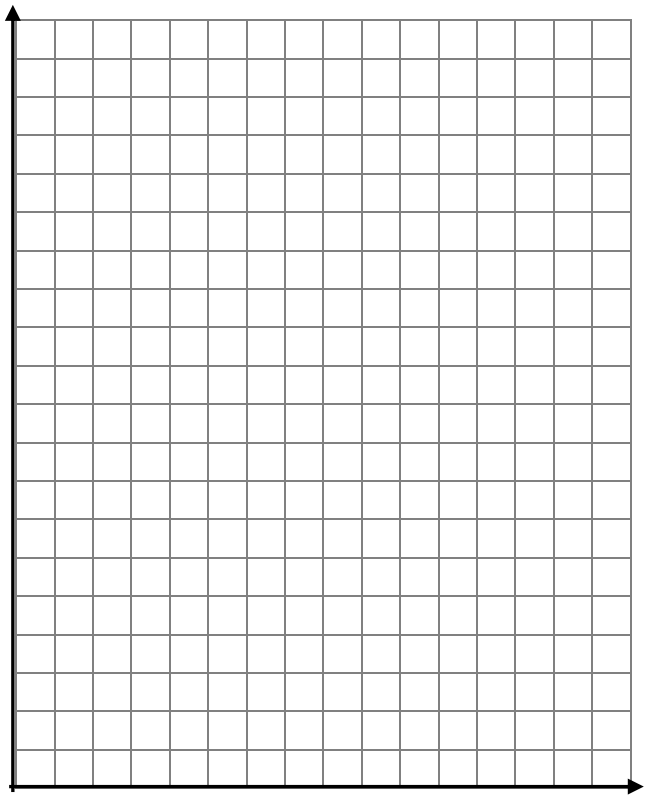
1. Andrew wants to start saving $60 per week. Write an equation that models his savings where x is the number of weeks and y is the amount in savings. Graph a line that tracks his account. Make a table if needed.



2. Logan opens a savings account with $200 she received in gifts. She plans to continue savings an additional $40 per week. Write an equation that models her savings where x is the number of weeks and y is the amount in savings. Graph a line that tracks her account. Make a table if needed.



3. Mrs. Keesler saved $60,000 for her maternity leave. She has to use $5,000 per month. Write an equation that models her spending where x is the number of weeks and y is the amount in savings. Graph a line that tracks her account. Make a table if needed.



4. Compare the equations of the three scenarios above. What does the number in front of the x (coefficient) represents? What does the constant represent?

If an equation doesn't have a constant value where will its graph always start?

If an equation has a negative coefficient what will its graph look like?

HW #34 Real Life Graph Scenarios Cont'd

1. Ana purchases school lunch every day for $3.50.

   Part A Write an equation that models this scenario where x represents the number of days and y is the total amount spent on lunch.

   Part B Describe what the graph of the equation above will look like if graphed on a coordinate plane. Where will the line start on the y – axis? At what rate will it increase?

2. Lucas rented a taxi for his trip to the airport. He was charged $15 plus $0.75 for each mile driven to the airport from his home.

   Part A Write an equation that models this scenario where x represents the number of miles and y is the total amount spent on the taxi.

   Part B Describe what the graph of the equation above will look like if graphed on a coordinate plane. Where will the line start on the y – axis? At what rate will it increase?

3. George was given a $60 Itune's gift card. He uses it to download new music. Each song he downloads costs $1.09.

   Part A Write an equation that models this scenario where x represents the number of songs downloaded and y is the total amount left on the gift card.

   Part B Describe what the graph of the equation above will look like if graphed on a coordinate plane. Where will the line start on the y – axis? At what rate will it increase?

Lesson #35 Slope - Intercept Form

All **linear equations** are written in the form y = mx + b or y = b – mx, where m is the slope and b is the y - intercept. This is called **slope - intercept form**.

Slope is defined as the _____ or the _____, which gives the steepness of the line.

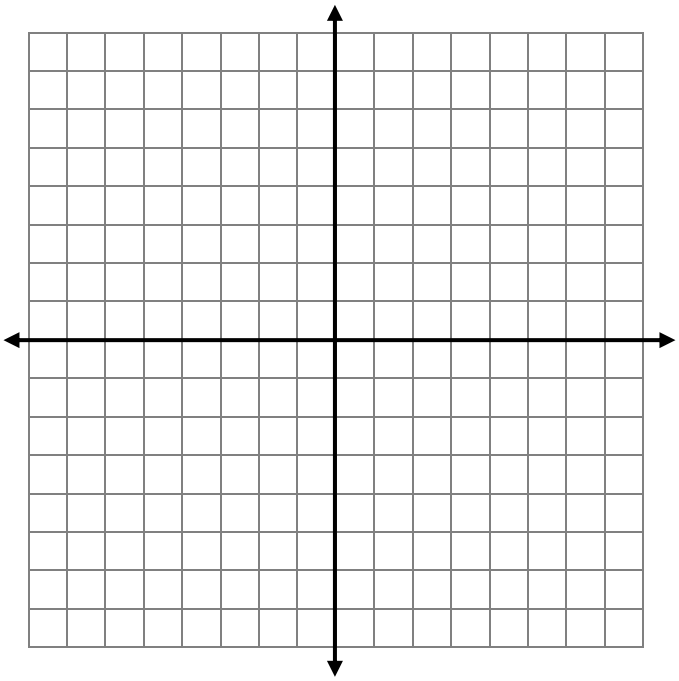
To graph an equation written in slope - intercept form:

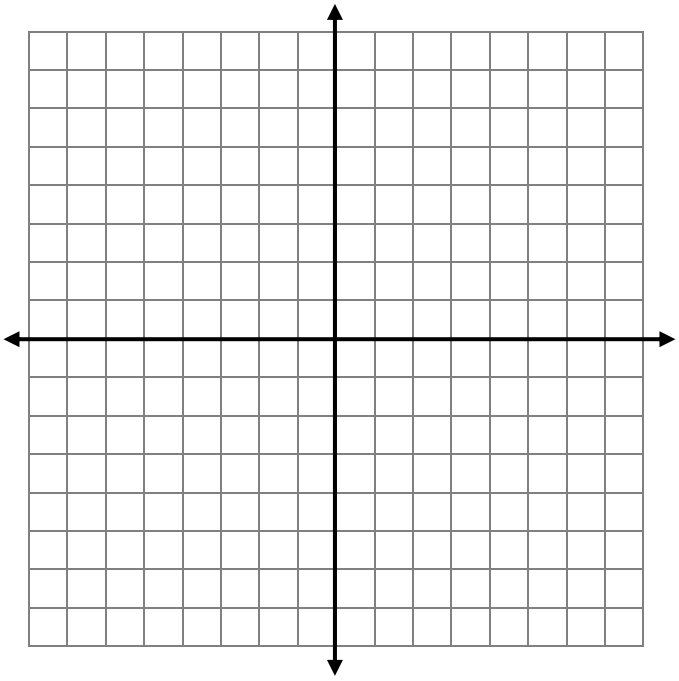
1. _____ the slope and y - intercept.
2. Graph the _____on the y – axis.
3. Use the _____ to locate points above and below the y - intercept.
4. Use a _____ to draw the line with arrows on each end.
5. Label the line with the _____.

Graph the following:

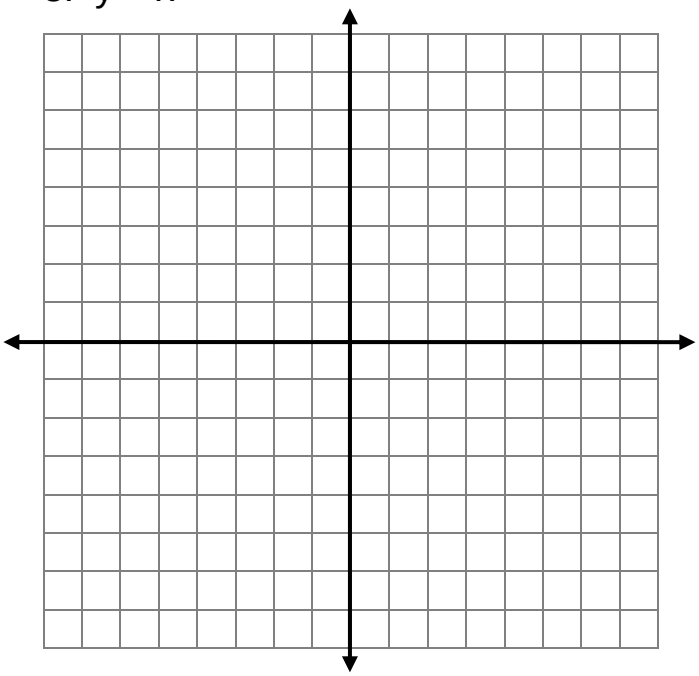
1. $y = \frac{1}{2}x$

2. $y = \frac{1}{2}x - 5$

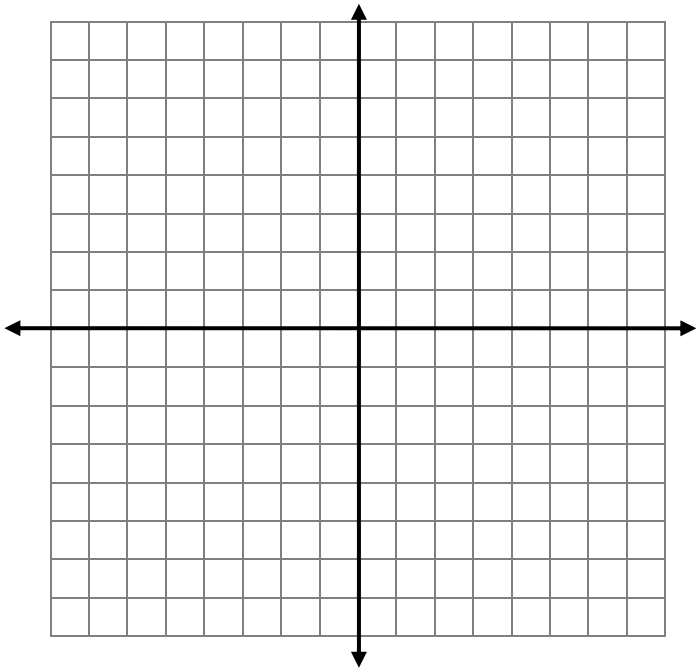




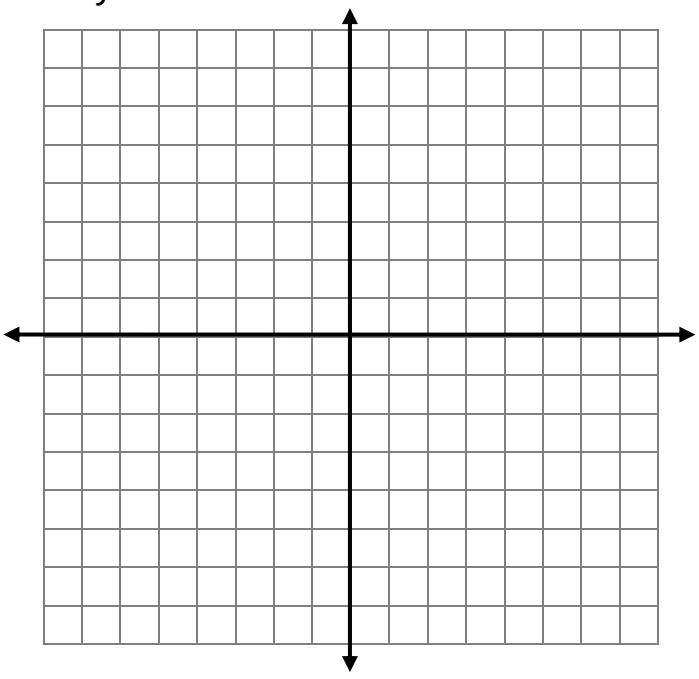
3. y = x



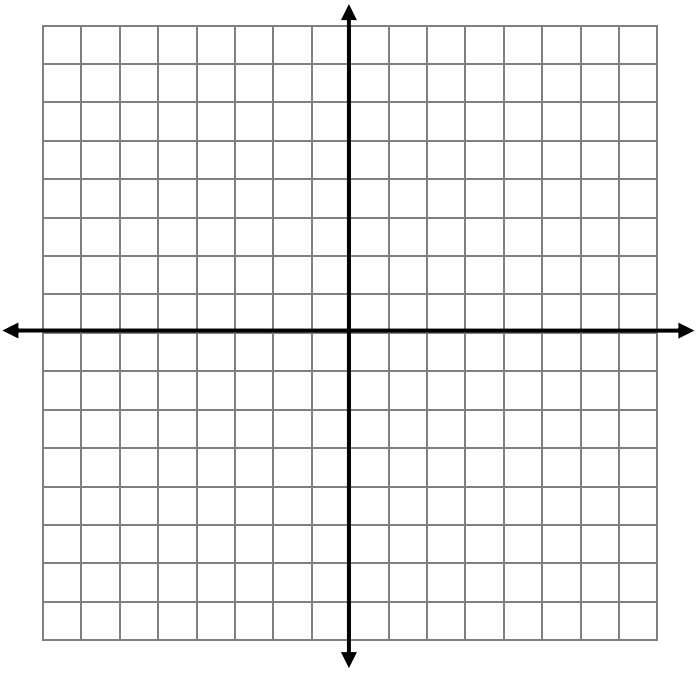
4. y = x + 4



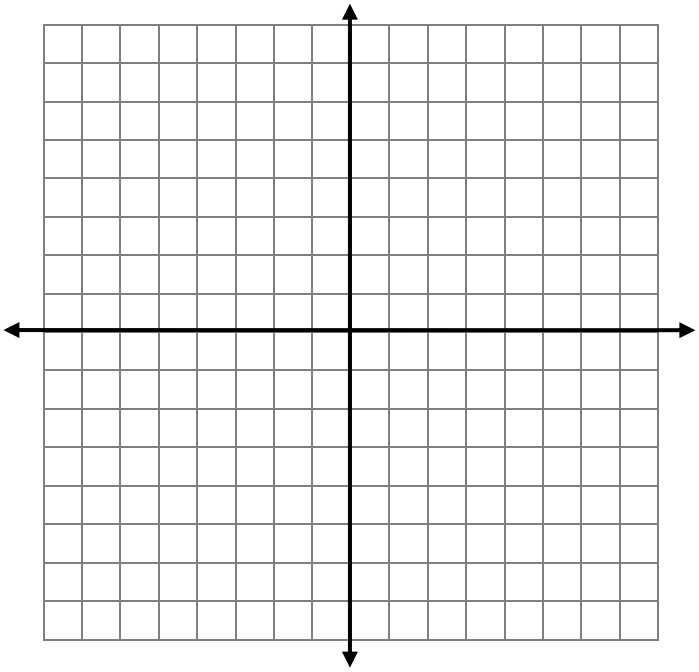
5. y = -2x



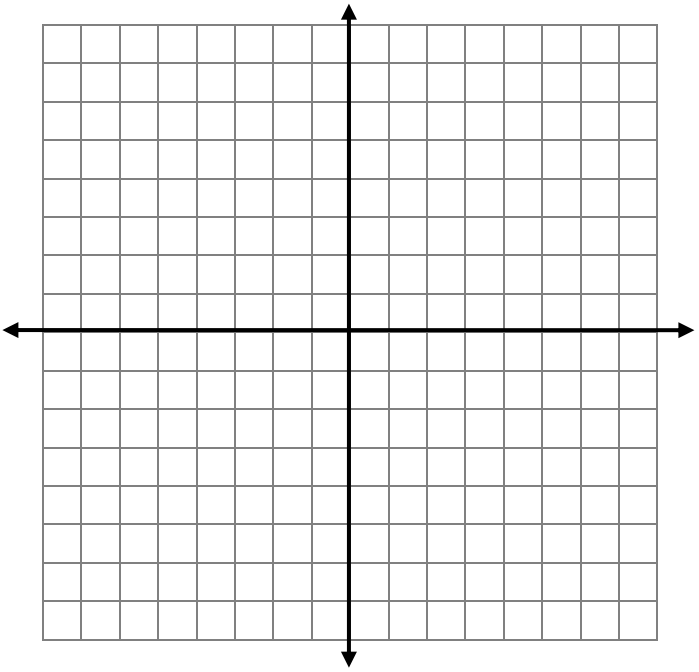
6. y = 3 – 2x



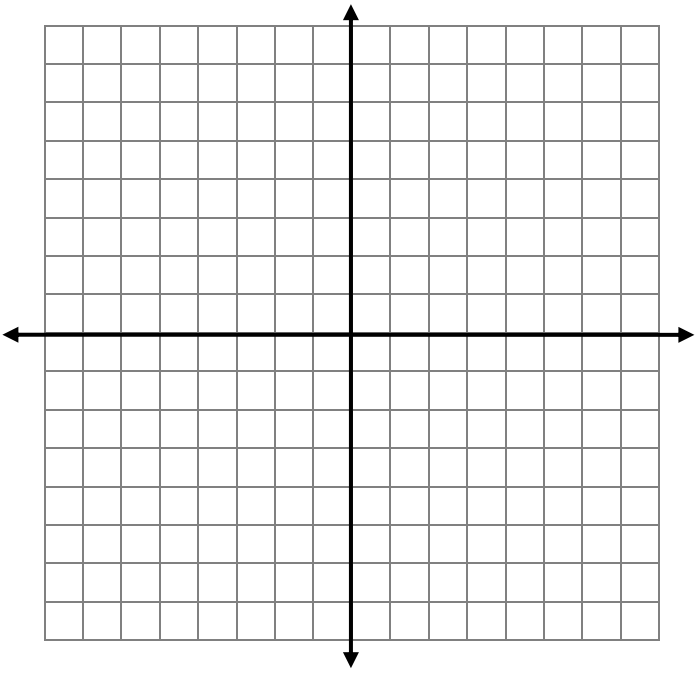
7. $y = \frac{3}{4}x$



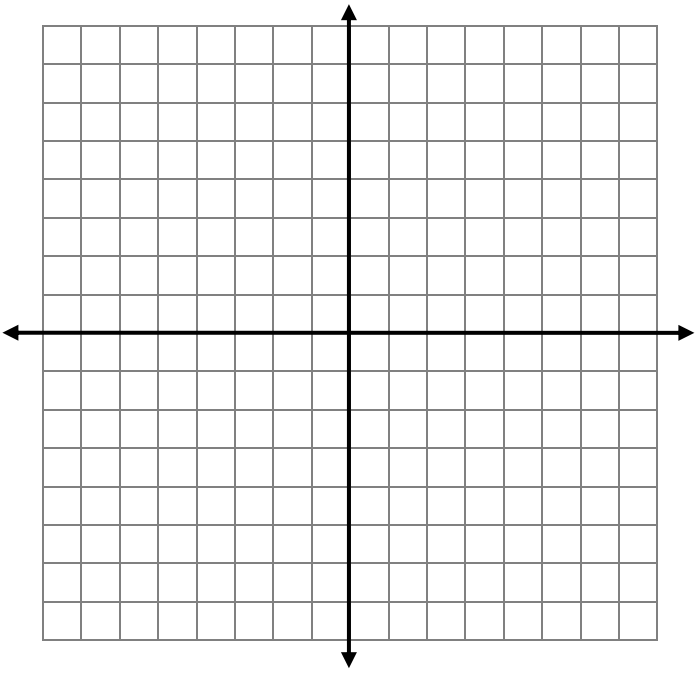
6. $y = \frac{3}{4}x + 1$



9. $y = -\frac{3}{2}x$



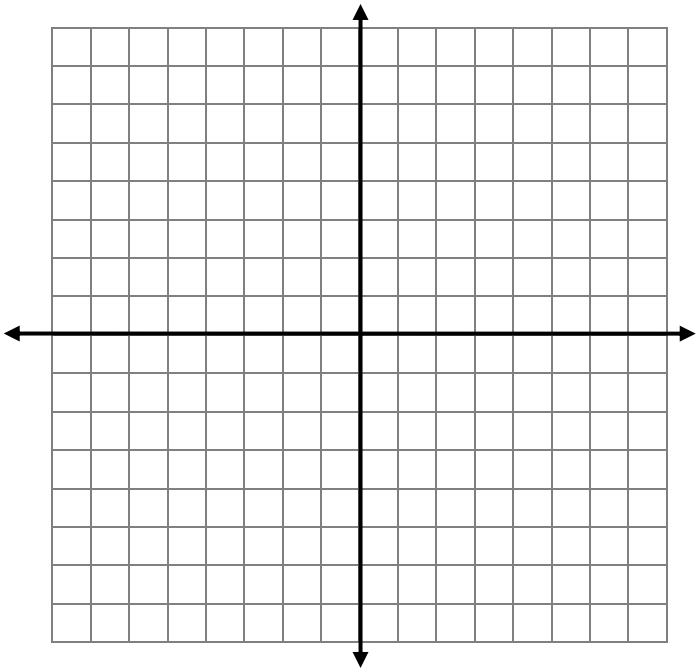
10. $y = \frac{3}{2}x - 7$



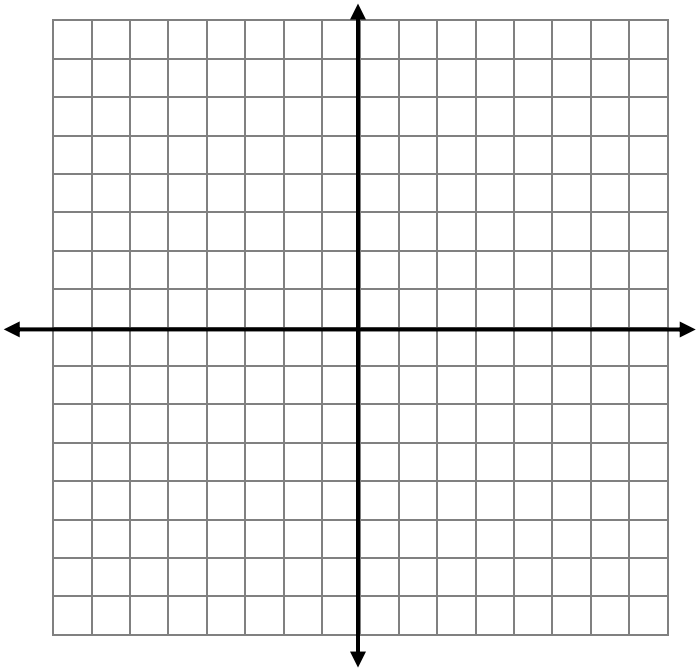
HW #35 Slope-Intercept Form

Given the slope and y-intercept, graph each line.

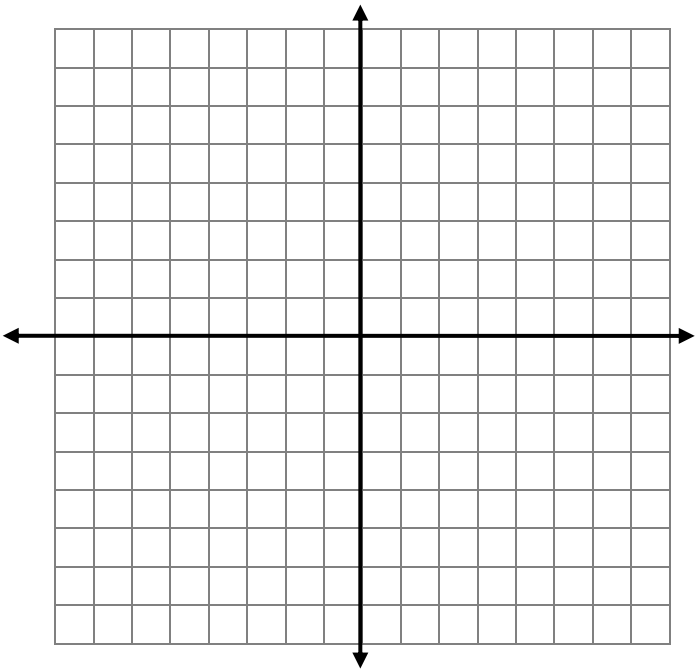
1. $y = 4x - 1$



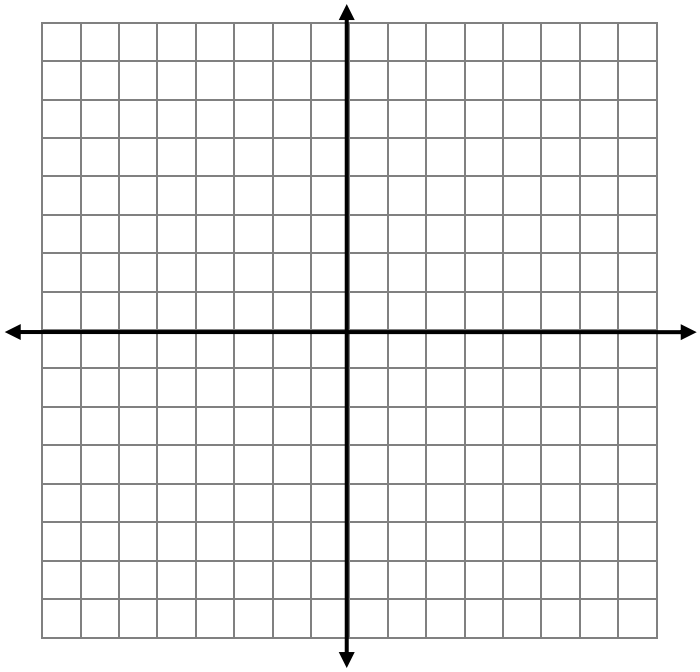
2. $y = 5 - \frac{1}{4}x$



3. $y = 3x - 2$



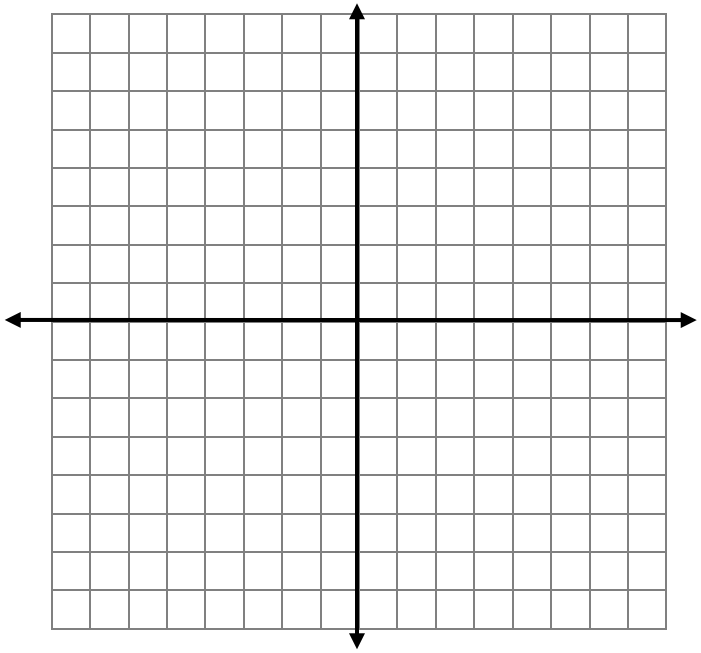
4. $y = -\frac{2}{3}x$



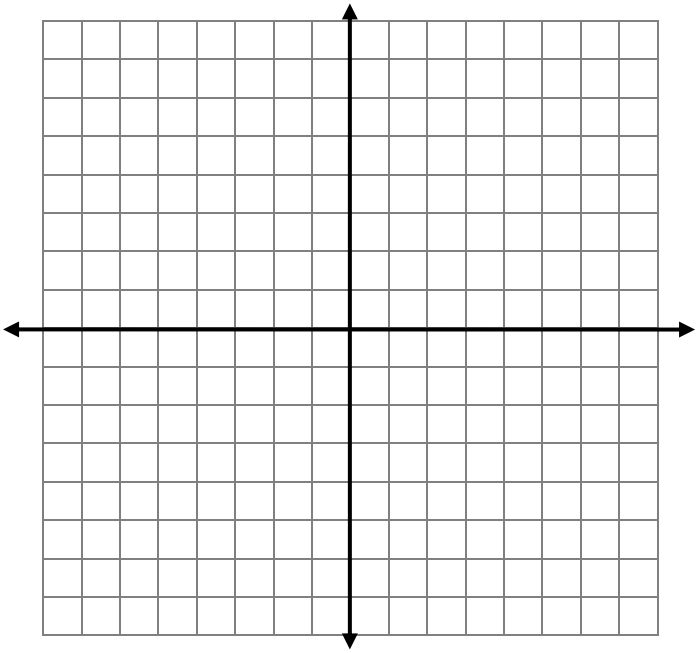
Lesson #36 Slope Intercept Form Continued

Graph each equation using the slope and y - intercept.

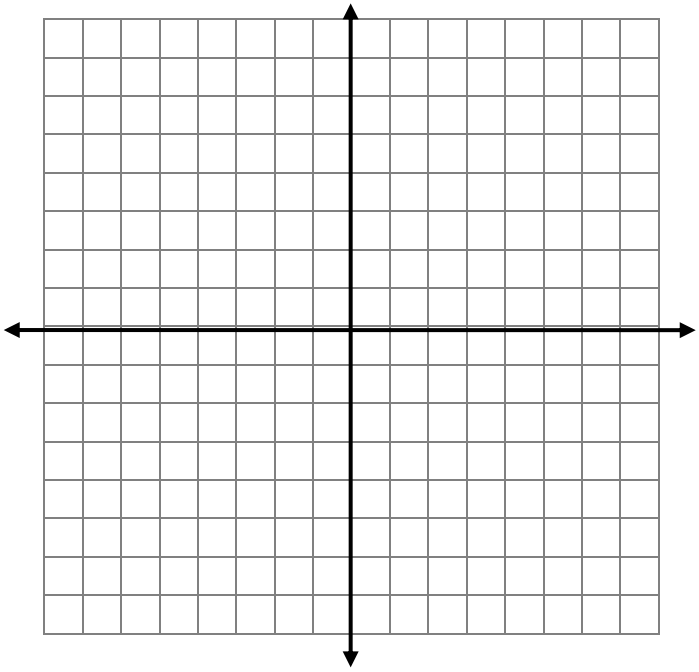
1. $y = 6 - x$



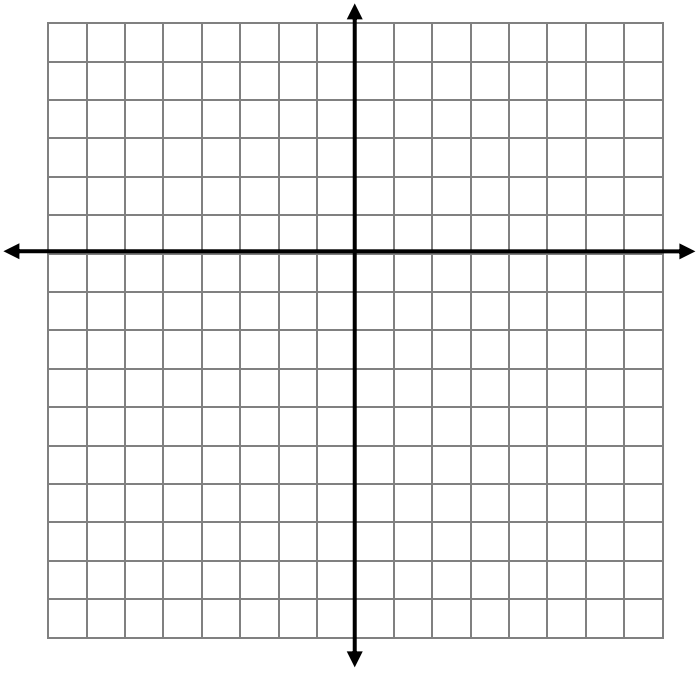
2. $y = \frac{1}{3}x$



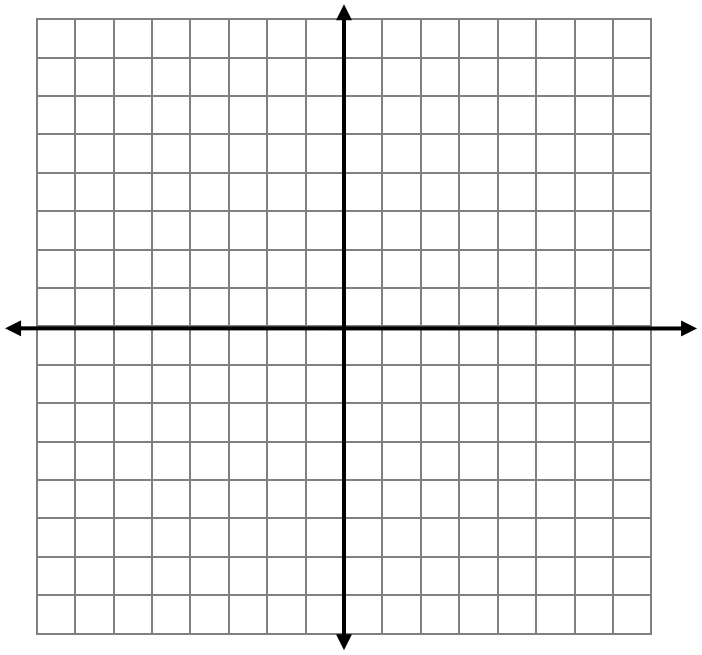
3. $y = 2x + 1$



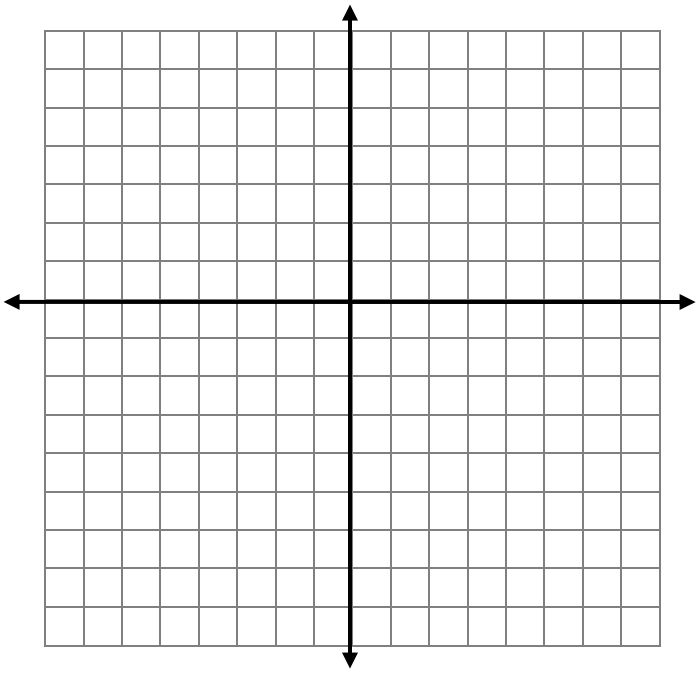
4. $y = -\frac{2}{3}x - 5$



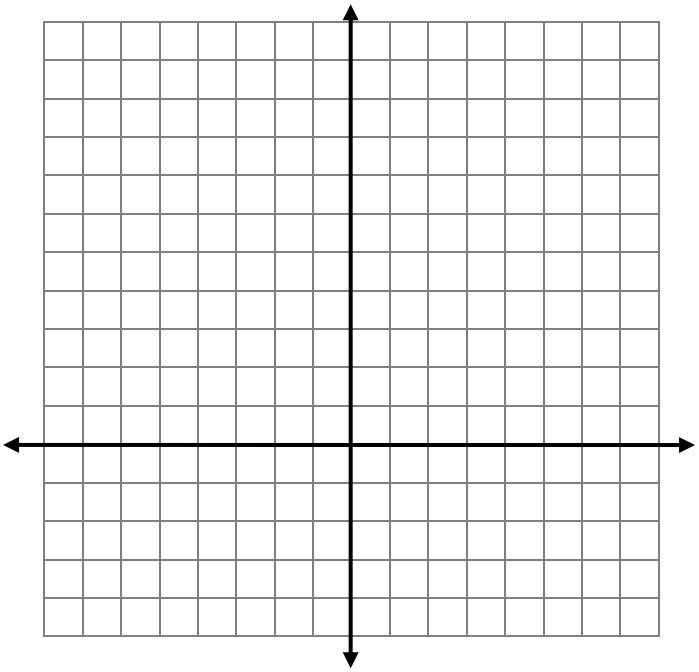
5. $y = 4 - 2x$



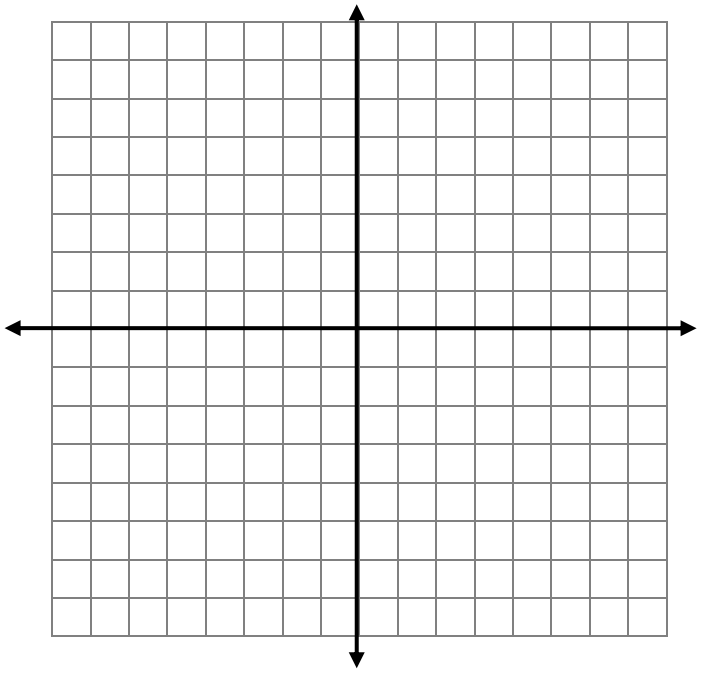
6. $y = \frac{4}{3}x - 2$



7. $y = 5 - 3x$



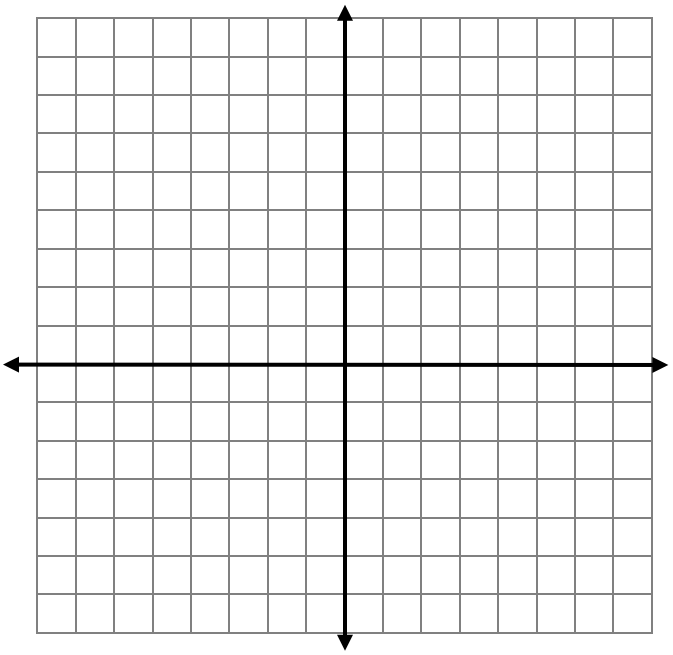
8. $y = 3 - \frac{1}{4}x$



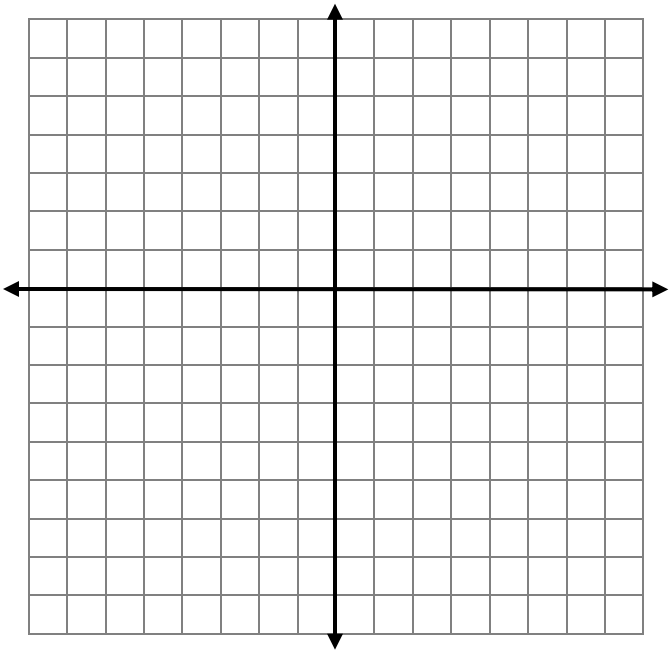
HW #36 Practice: Slope- Intercept Form

Given the slope and y-intercept, graph each line.

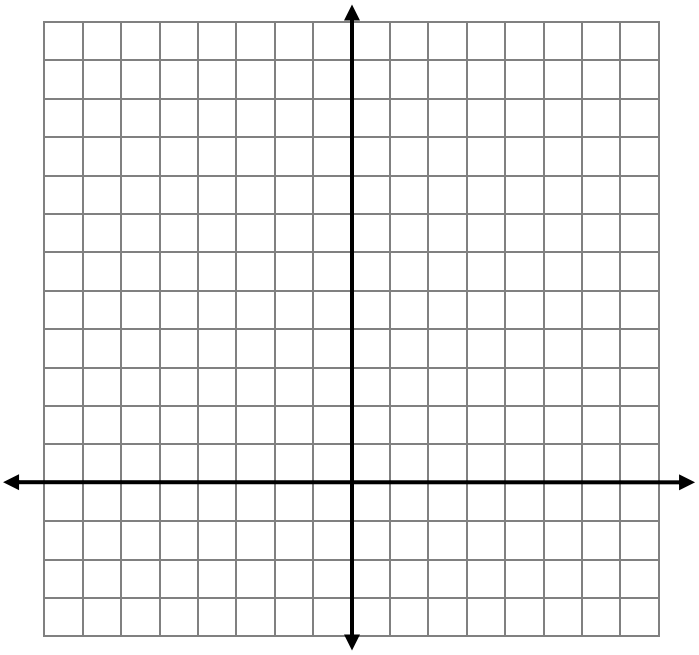
1. $y = 4 - \frac{1}{2}x$



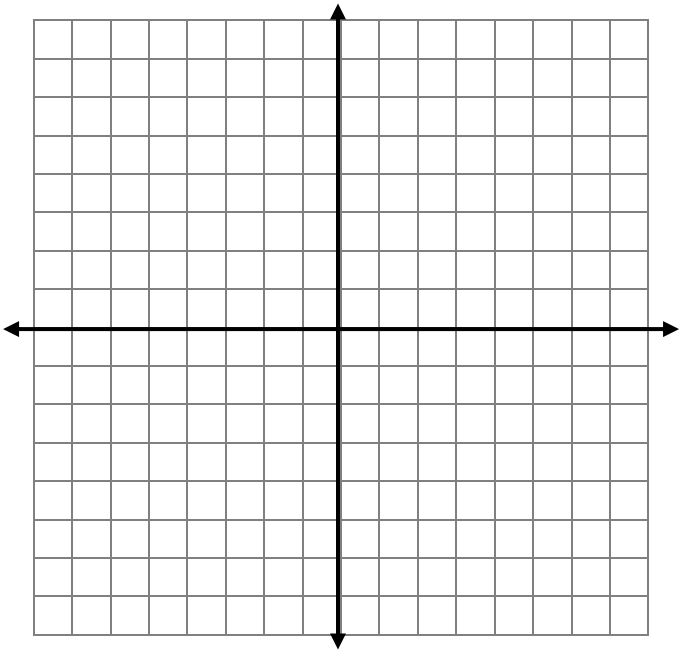
2. $y = 3x - 5$



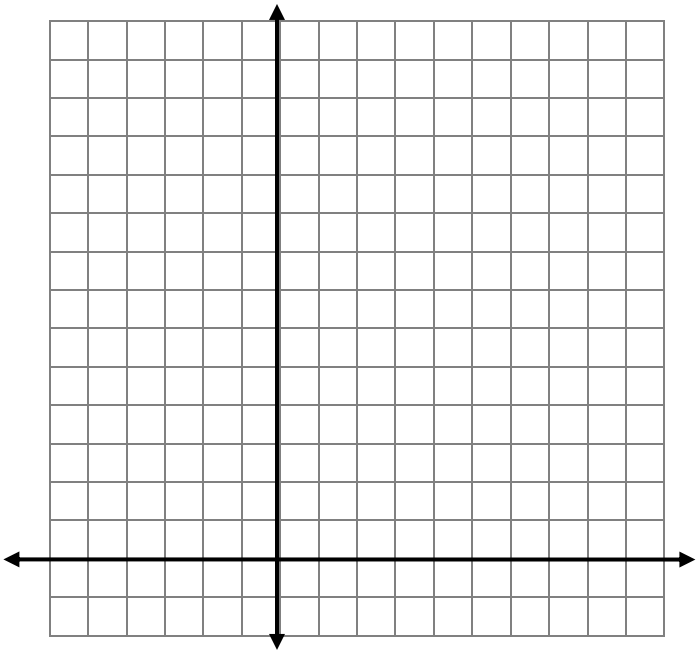
3. $y = 8 - 4x$



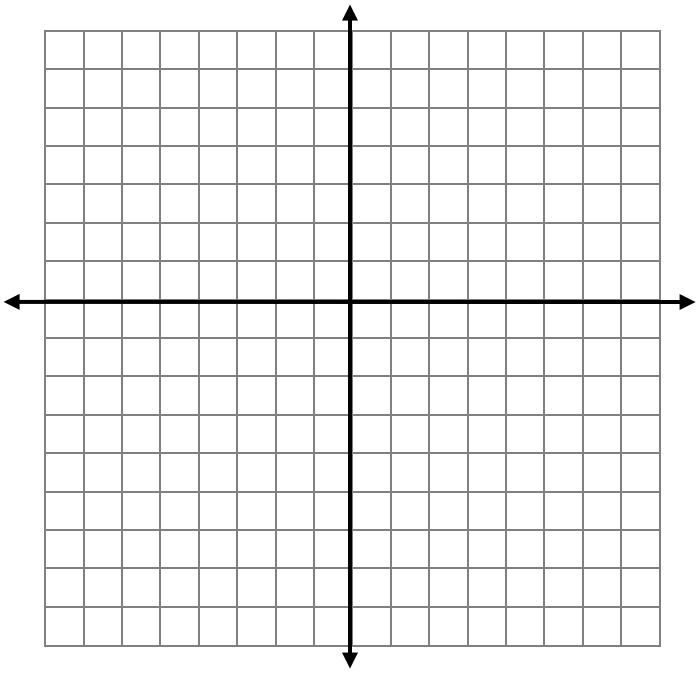
4. $y = \frac{4}{3}x$



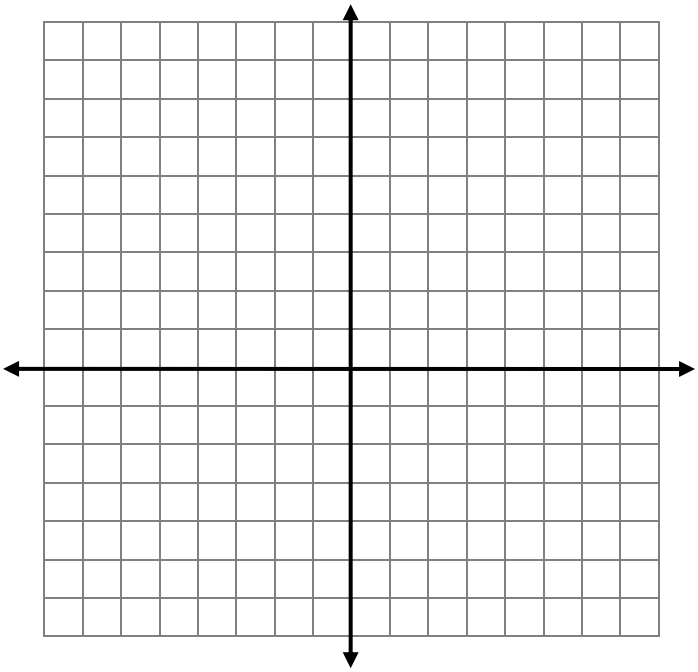
5. $y = 12 - x$



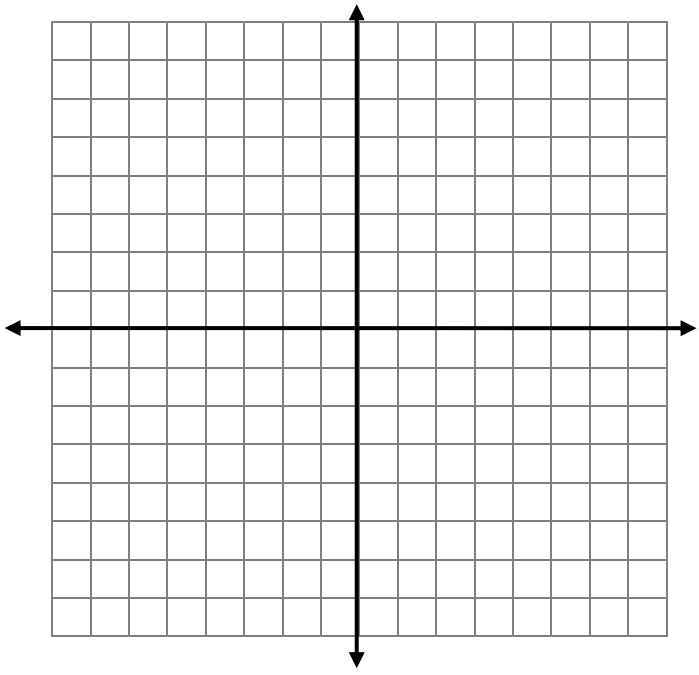
6. $y = \frac{2}{5}x$



7. $y = \frac{5}{2}x - 6$



8. $y = -\frac{3}{4}x + 7$



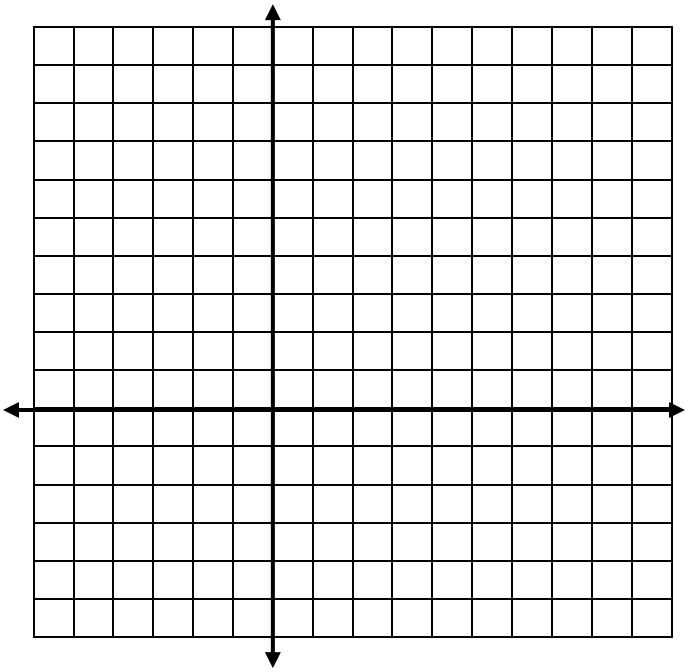
Lesson #37 Finding the Function Rule Given a Linear Graph

To write an equation of a line:

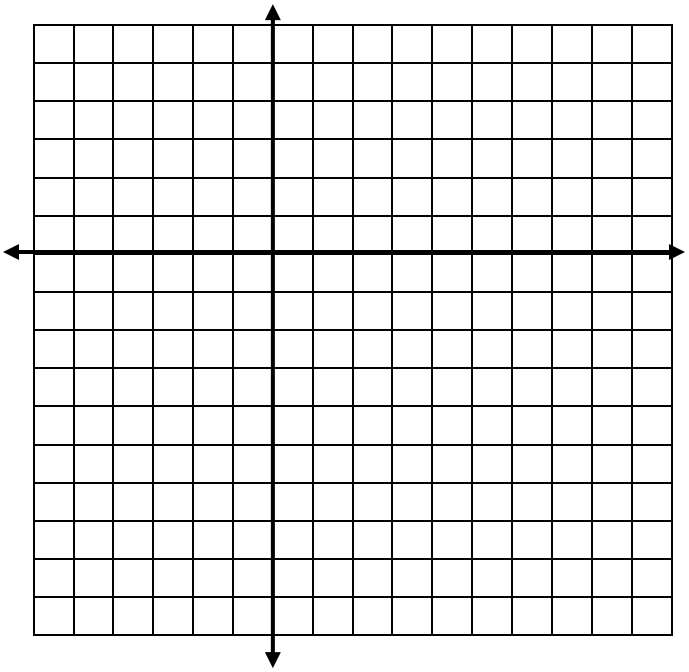
1. Find the _____.
2. Find the _____.
3. Substitute the _____and _____ into _____.

Try the following:

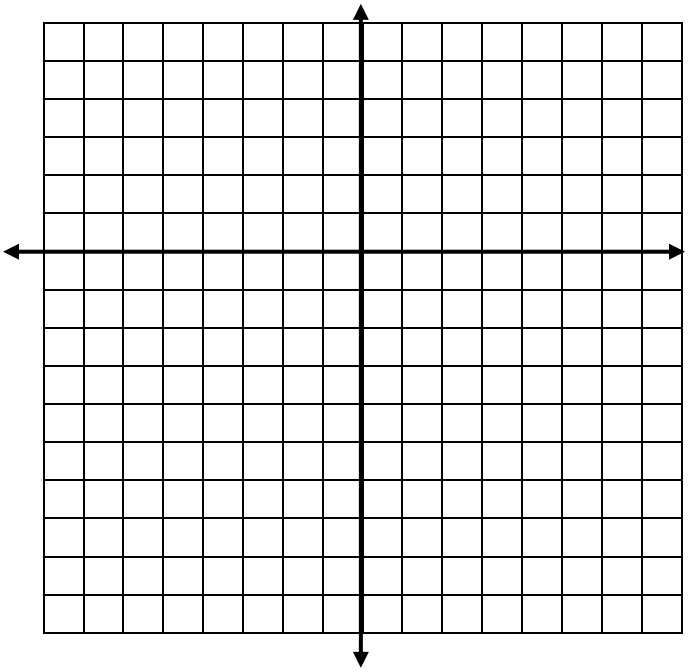
1. Line through (0, 2) and (6, 6)



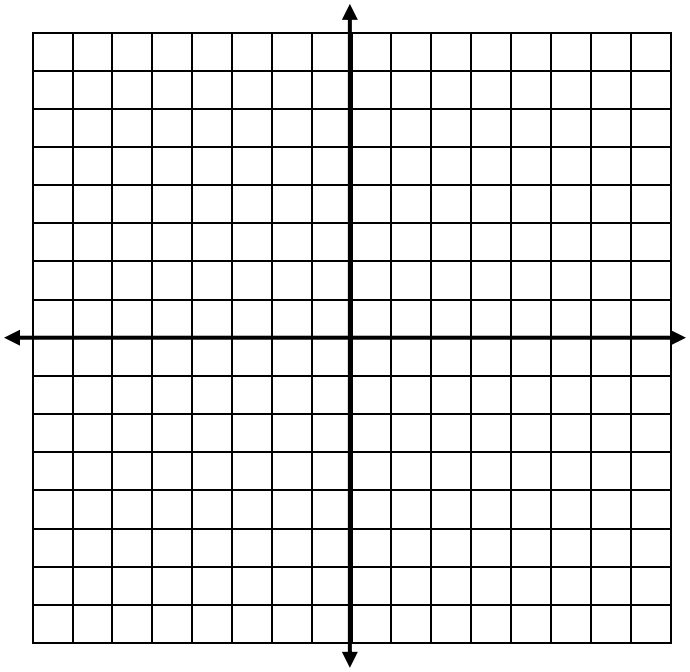
2. Line through (0,-4) and (2, -2)



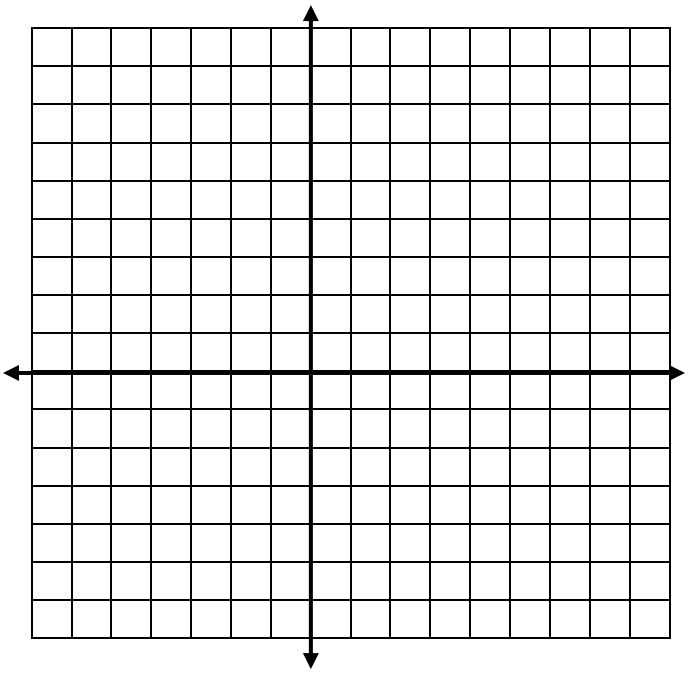
3. Line through (-2, -1) and (1, -7)



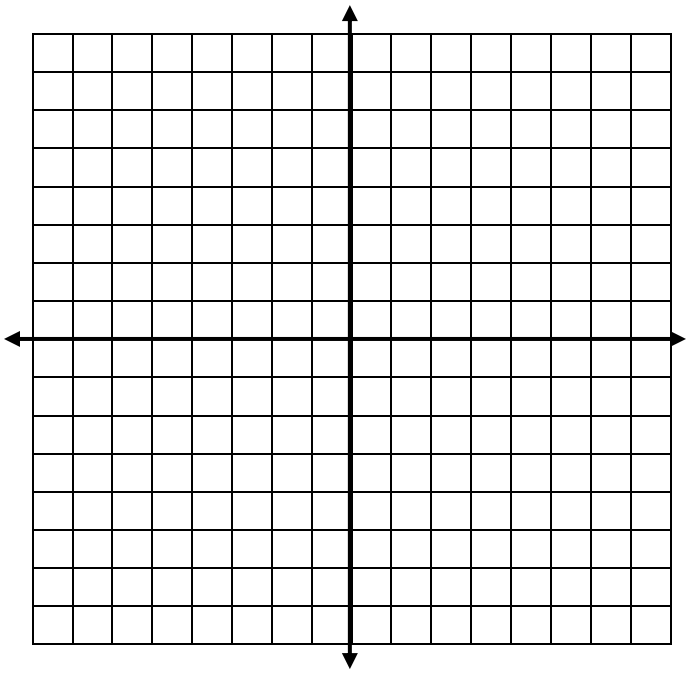
4. Line through (-4, 3) and (4, 1)



5. Line through (-2, -4) and (4, 5)



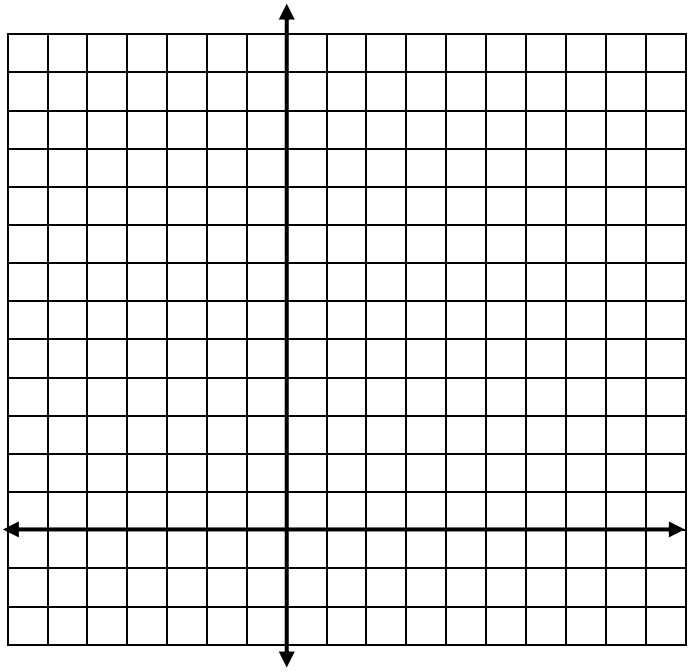
6. Line through (2, -5) and (-1, 7)



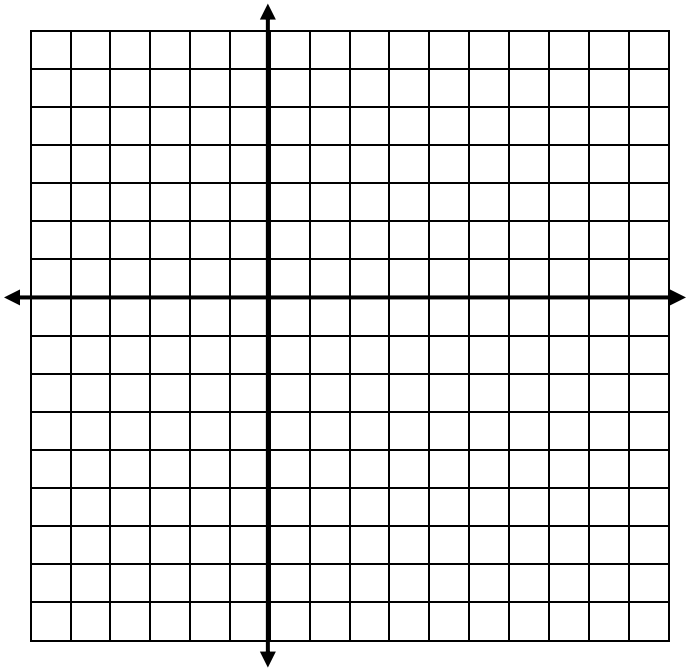
HW #37 Finding the Function Rule Given a Linear Graph

Write an equation in standard form for each line.

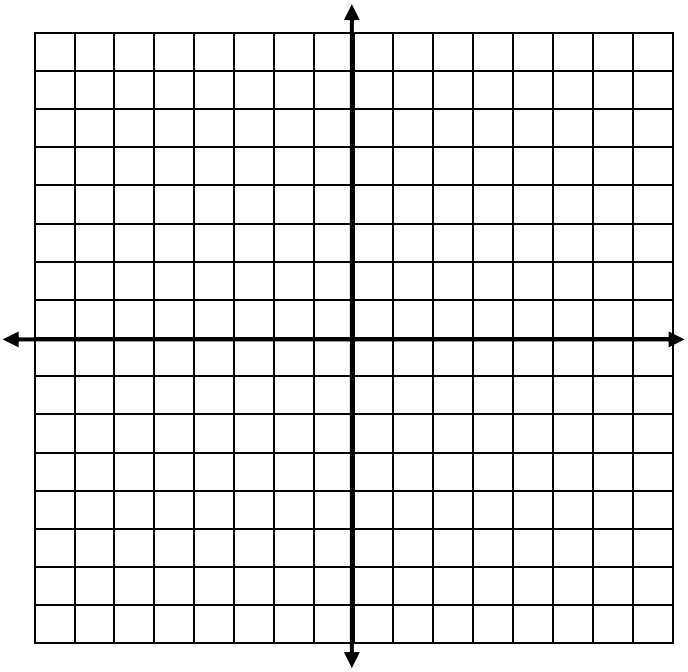
1. Line through (0, 2) and (3, 11)



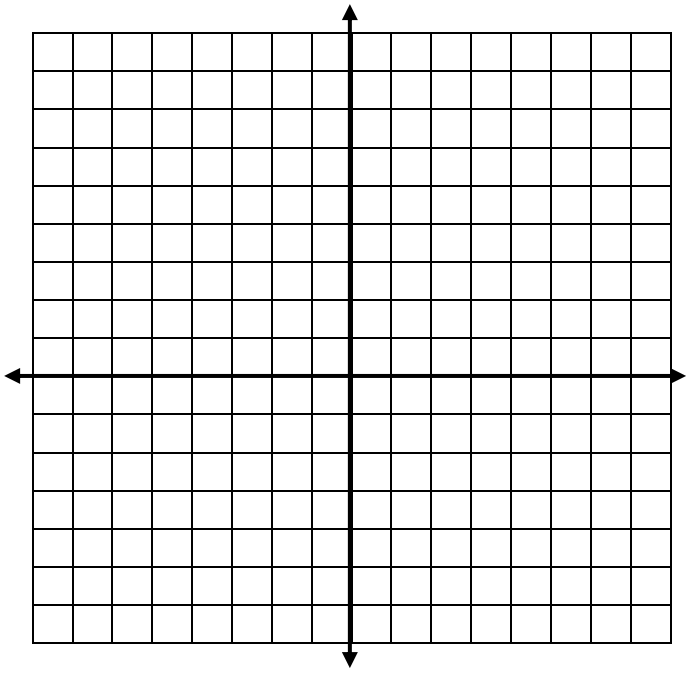
2. Line through (0, -3) and (8, -7)



3. Line through (-4, -4) and (4, 2)



4. Line through (-2, 8) and (3, 3)



Lesson #38 Find the Function Rule from a Table

To find the function rule given a table of values:

1. _____ or _____ the change in y by the change in x to find the coefficient (m).

2. _____ the m value and one point from the table into the equation y = mx+ b and solve for the constant (b).

3. Write the _____.

Examples: Find the function rule.

1.

x	y
-1	1
0	4
2	10
5	19

2.

x	y
-8	-1
-2	2
0	3
6	6

3.

x	y
-2	4
0	0
2	4
4	16

Try on your own:

4.

x	y
-2	-3
0	5
4	21
12	53

5.

x	y
-2	-7
0	-4
4	2
10	11

6.

x	y
-6	22
-2	12
0	7
8	-13

Examples:

7.

x	y
2	-6
4	-12
8	-24
14	-42

8.

x	y
2	-8
3	-7
5	-5
8	-2

9.

x	y
-3	-27
-1	-1
1	1
3	27

10.

x	y
4	5
8	2
16	-4
28	-13

Try on your own:

11.

x	Y
-6	-7
-3	-6
3	-4
12	-1

12.

x	y
6	4
9	2
15	-2
24	-8

HW #38: *Finding the Function Rule*

Directions: Find the function rule.

1.

x	y
-4	14
-2	7
0	0
6	-21

2.

x	y
-2	16
0	0
2	16
4	256

3.

x	y
-8	9
0	5
4	3
16	-3

4.

x	y
2	-2
4	4
8	16
14	34

5.

x	y
3	-4
6	-3
12	-1
21	2

6.

X	y
5	8
10	6
20	2
35	-4

Lesson #39 Real Life Functions

Functions can be used to help solve real world problems. Determine the functions needed in each scenario below. Then complete the corresponding table.

1. George keeps a table to determine how much he should pay his employees before taxes. Complete the table and write an equation that will help George.

Number of Hours	Salary
30	$270
32	$288
36	$324
40	
48	

If George pays an employee $225, how many hours did they work? _____

2. Janet keeps track of her track phone bill. Complete the table and write an equation that will help Janet.

Number of Minutes	Bill Amount
100	32
150	33
250	35
400	
550	

If Janet is billed $50, how many minutes did she use? _____

3. Emily wants to put a certain amount of her spending money from her paycheck into savings each week. Write an equation to help Emily determine how much money she should put into savings based on her pay amount.

Paycheck	Savings Amount
$200	$25
$250	$37.50
$300	$50
$400	
$550	

If Emily puts away $100 one week, how much did she make that week? _____

4. Jeremy bills his customer each times he plows. He has come up with a way of determining how much the bill should be. Complete the table and determine an equation that will help Jeremy.

Length of Driveway	Price
20	$40
25	$42.50
35	$47.50
50	
65	

If Jeremy bills a customer $46, how long is their driveway? _____

HW #39: Finding Real Life Function Rules

Directions: Complete each table and find the function rule that can be used for each situation.

1. James likes to keep track of how much gas he uses on road trips. He has made up the chart below to determine how much gas he will need. Complete the table and determine a function rule to help James.

Gallons	Distance (miles)
10	180
15	270
25	450
40	720
55	
80	

If James travels 630 miles, how many gallons of gas will he need?

2. Maria subscribes to a music company online to download her favorite songs. She has kept track of her last 6 monthly bills. Complete the chart and determine a function rule to help Maria.

Number of Songs	Bill Amount
10	$13
12	$14
16	$16
20	
25	

If Maria is billed $24, how many songs did she download?

3. Donnie wants to put a portion of his paycheck into savings each week. He has come up with a chart to help him do this. Complete the chart and write a function rule that will help Donnie.

Paycheck	Savings Amount
$500	$20
$550	$25
$590	$29
$650	$35
$720	
$780	

If Donnie saves $32 one week, how much money did he earn?

Lesson #40 Finding the Function Rule that Crosses Two Points

You can find the equation of the line that passes through two points without graphing as well.

1. Place the given coordinates in a _____**.**
2. Find the slope, _____.
3. Find the y – intercept, by substituting the _____ and one of the given _____ into y = mx + b and solving for b.
4. Rewrite the _____ with the values found in step two and three.

Examples:

1. M(0, -8) and A(5, 2)

2. T(-10, 3) and H(0, -2)

Try on your own:

3. L(0, -9) and O(4, 3)

4. V(-6, 6) and E(0, 4)

5. P(0, 1) and L(4, -5)

6. U(-5, 0) and S(0, 5)

More Examples:

7. A(-5, 2) and B(3, 18)

8. C(-4, 6) and D(2, -12)

9. D(-2, -4) and E(4, 5)

10. F(-9, 8) and G(3, -8)

Try on your own:

11. H(-2, -5) and I(3,15)

12. J(-4, 12) and K(4, 6)

HW #40 Finding the Function Rule that Crosses Two Points

Find the linear function rule that will pass through each set of points without graphing.

1. N(-5, -10) and E(0, 10)

2. A(10, 2) and T(0, 7)

3. L(12, 0) and I(0, 4)

4. N(2, 6) and E(5, 15)

5. M(-2, -16) and A(4, 14)

6. T(-3, 1) and H(3, -3)

Lesson #41 Finding the Function Rule Continued

You may be asked to find the function rule when given only two sets of data in a real life problem.

1. Remember the formula _____.
2. Set up a _____.
3. Determine the _____ by calculating the change in y by the change in x.
4. Substitute _____ into the equation and solve for _____.
5. _____ the equation, substituting in both m and b.

Examples given a table of values:

1. Caitlyn has a movie rental card worth $175. After she rents the first movie, the card's value is$172.25. After she rents the second movie, its value is $169.50. After she rents the third movie, the card is worth $166.75. Assuming the pattern continues, write an equation, A(n) that determines the amount of money on the card, after any number of rentals (n). How many movies can Caitlyn rent with her card?

2. A trainer for a professional football team keeps track of the amount of water players consume throughout practice. The trainer observes that the amount of water consumed is a linear function of the temperature on a given day. The trainer finds that when it is 90°F the players consume about 220 gallons of water, and when it is 76°F the players consume about 178 gallons of water. Write a linear function, g(t) to model the relationship between gallons of water consumed and temperature (t). How many gallons of water will the team consume when it is 84°F?

3. The number of dollars per month it costs you to own a car is a function of the number of kilometers per month you drive it. Based on information in an issue of ***Time*** magazine, the cost varies linearly with the distance, and is $366 per month for 300 km per month, and $510 per month for 1500 km per month. Write a linear function, C(d) to model the relationship between cost and distance (d). Predict the monthly cost of owning a car if you travel 1,000 km a month.

4. The size of a shoe a person needs varies linearly with the length of his or her foot. The smallest adult shoe size is Size 5, and fits a 9-inch long foot. An 11-inch long foot takes a Size 11 shoe. Write a linear function, S(f) to model the relationship between shoe size and foot length (f). If your foot is a foot long what size do you need?

5. The speed a bullet is traveling depends on the number of feet the bullet has traveled since it left the gun. The bullet is traveling at 3500 ft./sec. when it is 25 feet from the gun, and at 2600 ft./sec., it is 250 feet away. Write a linear function, S(d), to model the relationship between speed of the bullet and distance from the gun (d). How fast is a bullet when it has reached a distance of 300 ft?

HW #41 Finding the Function Rule Cont'd

Directions: Write a linear function that models each situation below. Substitute the given value into the equation.

1. To take a taxi in downtown St. Louis, it will cost you $3.00 to go a mile. After 6 miles, it will cost $5.25. The cost varies linearly with the distance traveled. Write a linear function, C(d), to model the relationship between cost and distance (d). How much will it cost to travel 10 miles?

2. Based on information in *Deep River Jim's Wilderness Trailbook*, the rate at which crickets chirp is a linear function of temperature. At 59˚F they make 76 chirps per minute, and at 65˚F they make 100 chirps per minute. Write a linear function, C(t) to model the relationship between number of chirps and temperature(t). Predict the number of chirps a cricket will make in a minute if it is 90°F.

3. The Magic Market sells one-gallon cartons of milk (4 quarts) for $3.09 each and half gallon (2 quarts) cartons for $1.65 each. Assume that the number of cents you pay for a carton of milk varies linearly with the number of quarts the carton holds. Write a linear function, P(q), to model the relationship between the price and the number of quarts (q). If Magic Market sells three gallon cartons (remember there are 4 quarts in a gallon), how much will they cost?

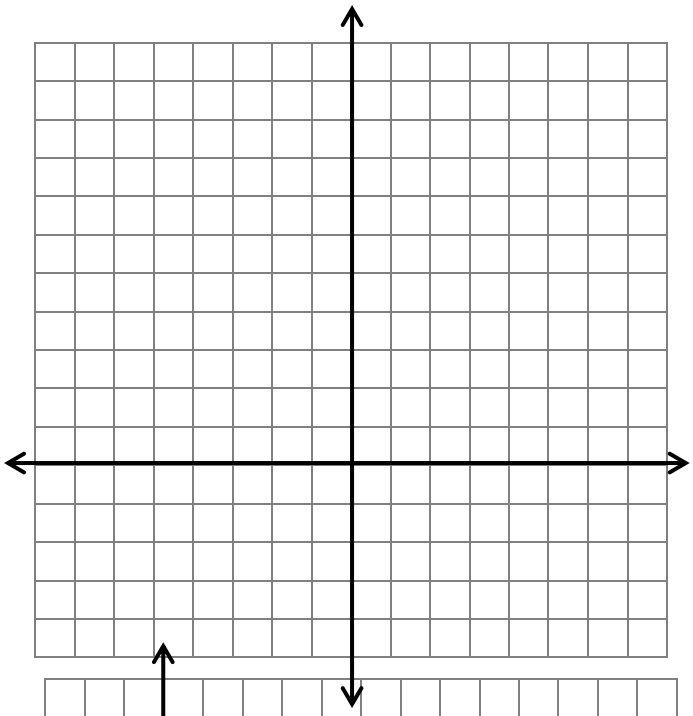
4. Chase has an Itune's gift card for $75. After purchasing 4 games for his ipad he only has $31.84 left. Assuming that all of the games Chase purchases are the same price, determine the function rule, C(g) that relates the amount of money left on Chase's card after any number of games (g) purchased. How many games can Chase purchase at this price.

Lesson #42 Linear and Nonlinear Functions.

Graph each of the following, state whether the function is linear or nonlinear and explain why!

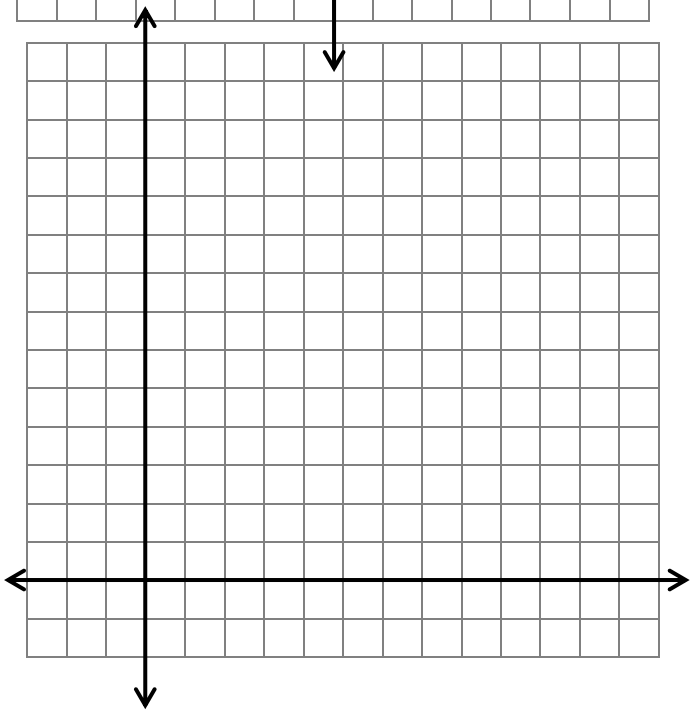
1. f(x) = -2x + 3

x	f(x)
-4	
-2	
0	
2	
4	



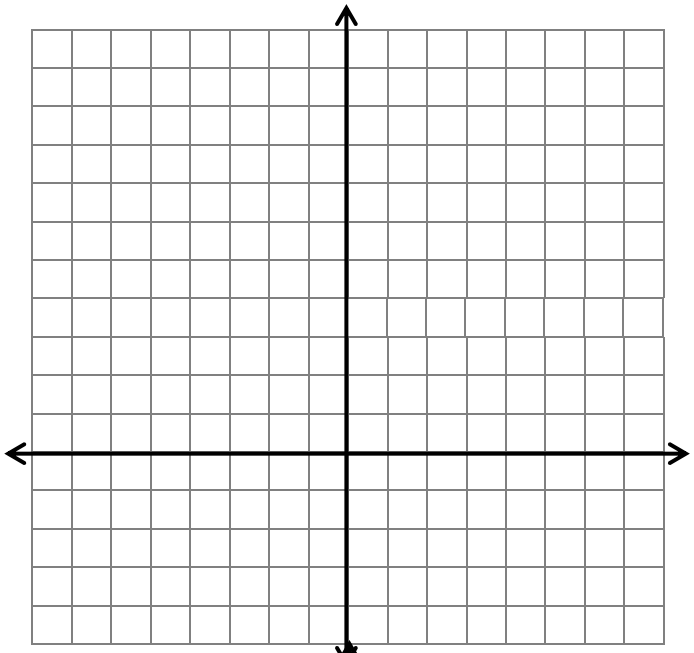
2. f(x) = $\frac{8}{x} - 2$

x	f(x)
$\frac{1}{2}$	
1	
2	
4	
8	



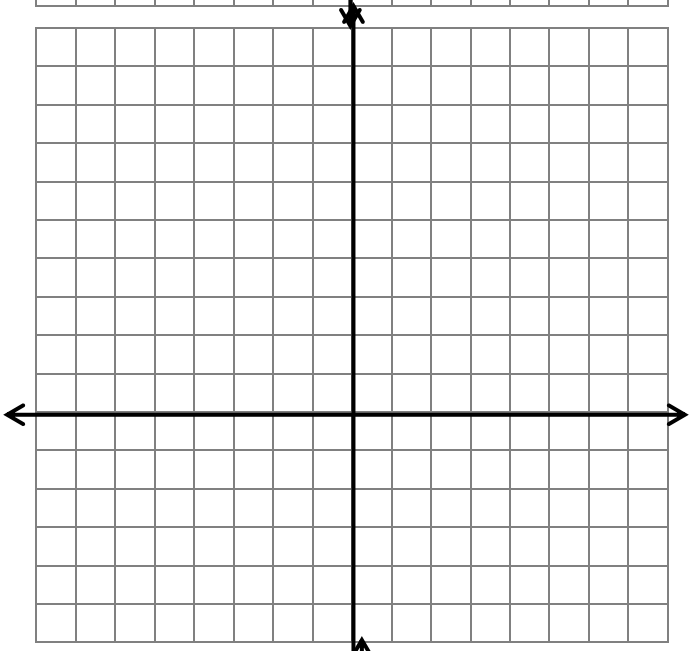
3. $f(x) = x^2 - 5$

x	f(x)
-4	
-2	
0	
2	
4	



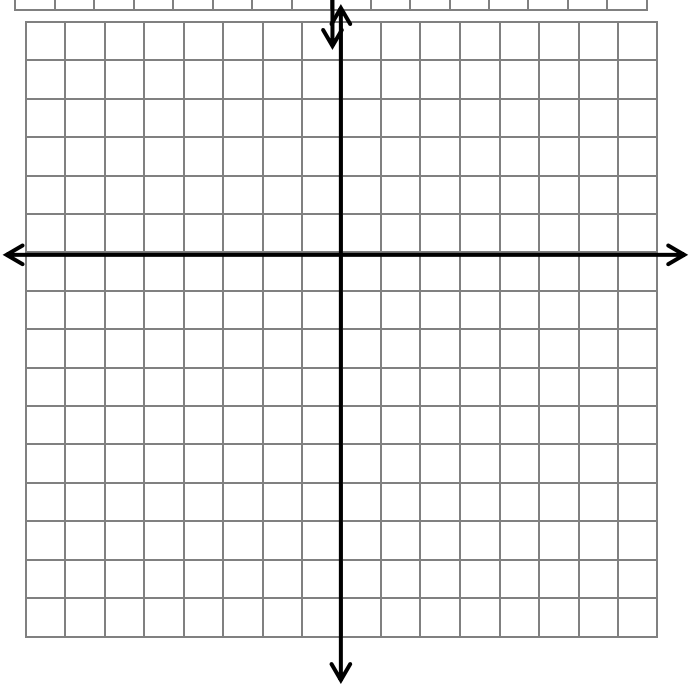
4. $f(x) = \frac{1}{3}x + 4$

x	f(x)
-6	
-3	
0	
3	
6	



5. $y = x^3 - 2$

x	f(x)
-2	
-1	
0	
1	
2	

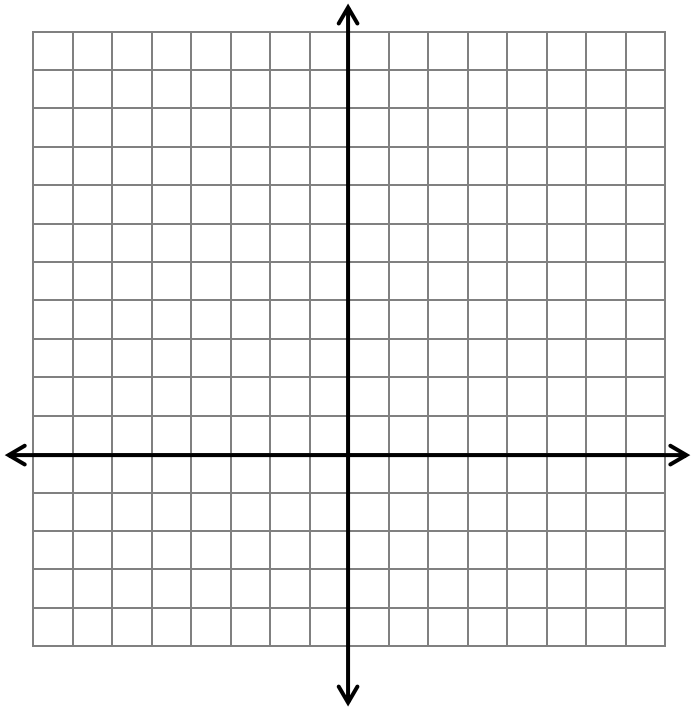


HW #42 Graphing More Functions

Graph each of the following, state whether the function is linear or nonlinear and explain why!

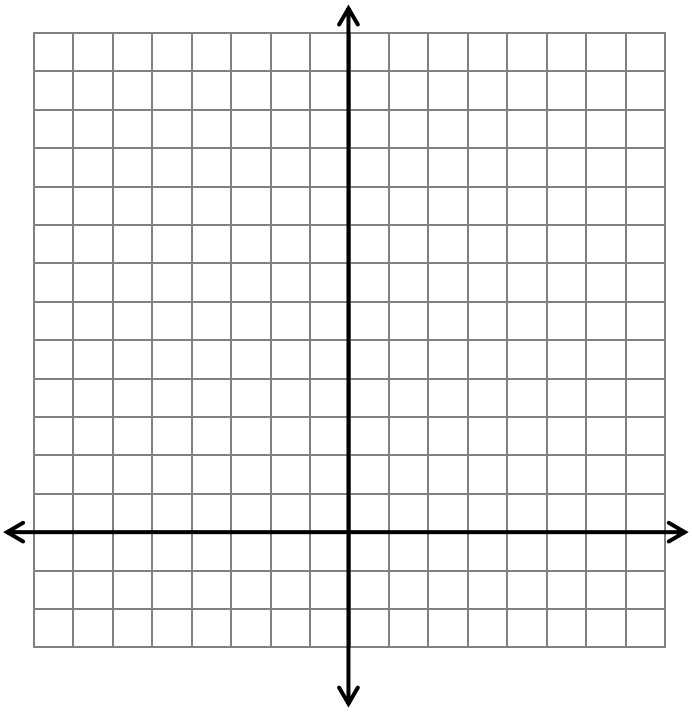
1. f(x) = $\frac{1}{4}x + 3$

x	f(x)
-8	
-4	
0	
4	
8	



2. f(x) = $x^2 - 3$

x	f(x)
-4	
-2	
0	
2	
4	

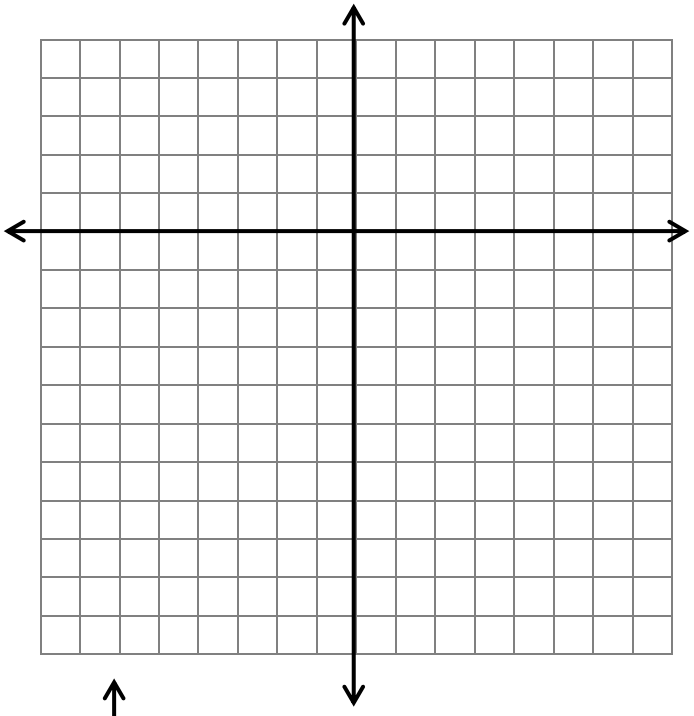


Lesson #43 Graphing More Functions

Graph each of the following, state whether the function is linear or nonlinear and explain why!

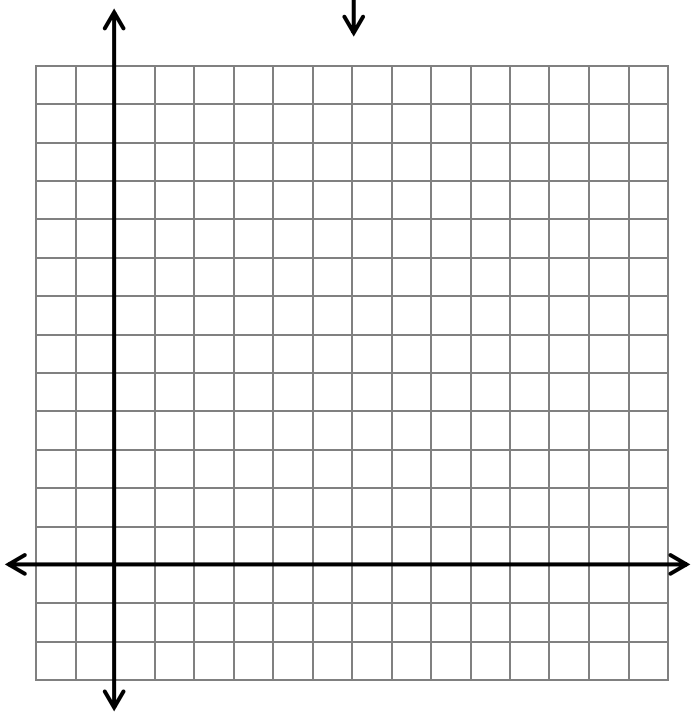
1. $f(x) = \frac{3}{4}x - 5$

x	f(x)
-8	
-4	
0	
4	
8	



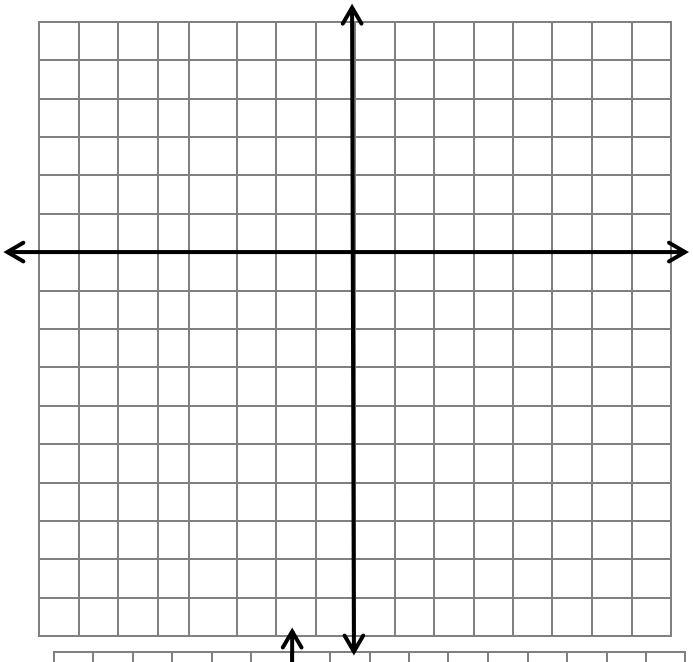
2. $f(x) = \frac{1}{x} + 3$

x	f(x)
0.25	
0.5	
0.75	
1	
2	



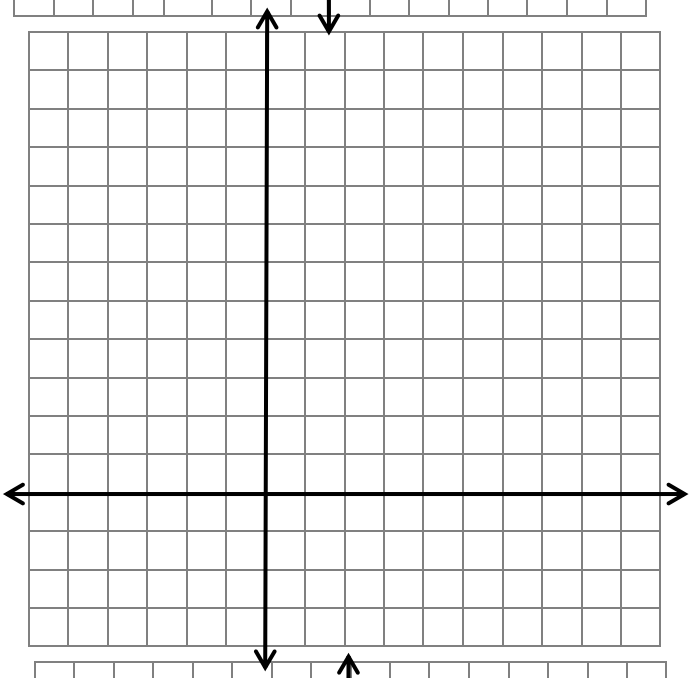
3. $f(x) = 6 - x^2$

x	f(x)
-4	
-2	
0	
2	
4	



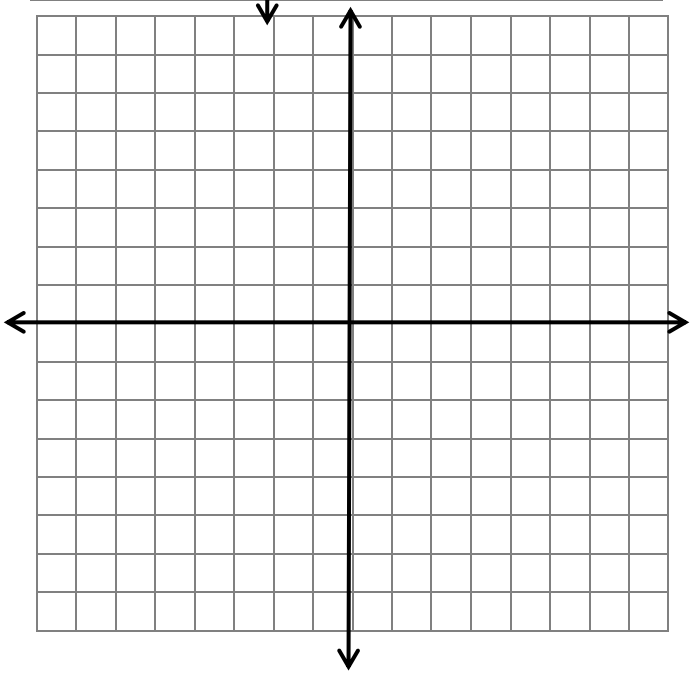
4. $f(x) = 2^x$

x	f(x)
-2	
-1	
0	
1	
2	
3	



5. $f(x) = \frac{1}{2}x^3$

x	f(x)
-4	
-2	
0	
2	
4	



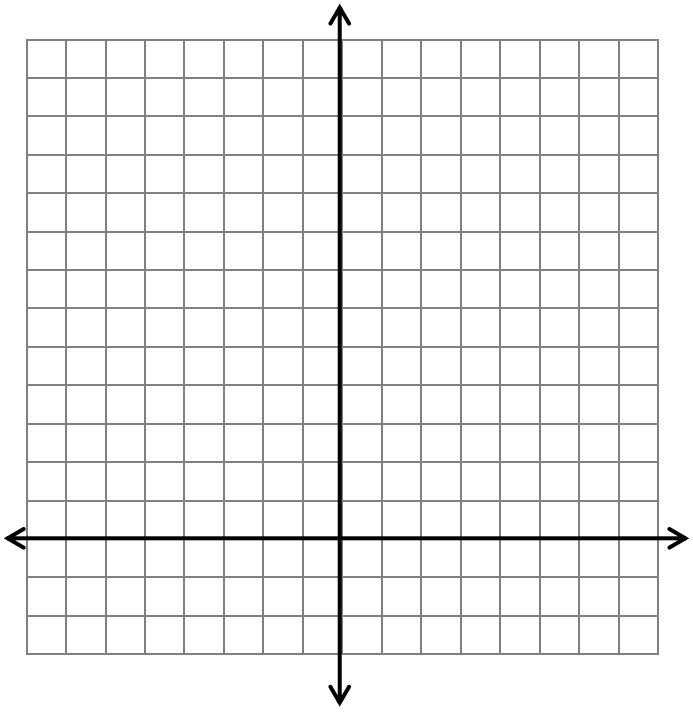
**Label y axis in multiples of 4.

HW #43 Graphing More Functions

Graph each of the following, state whether the function is linear or nonlinear and explain why!

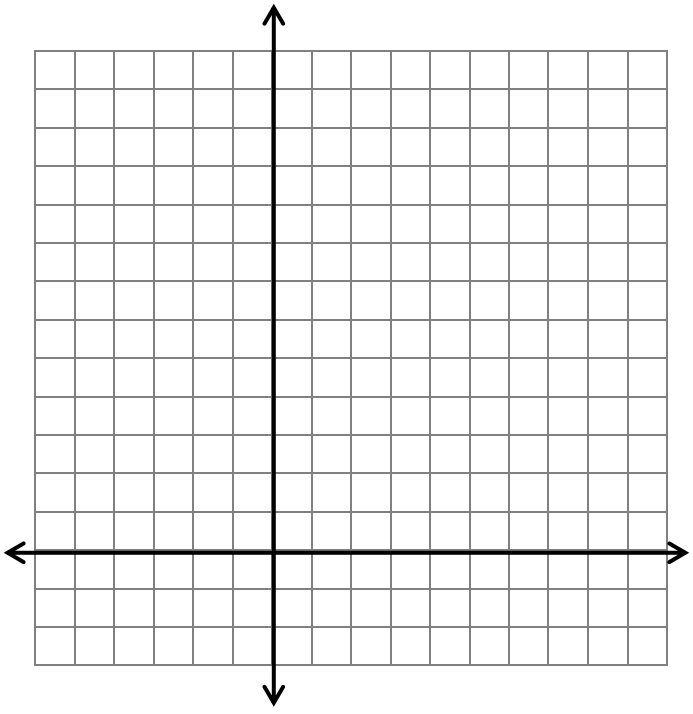
1. f(x) = $8 - \frac{1}{3}x$

x	f(x)
-6	
-3	
0	
3	
6	



2. f(x) = 3^x

x	f(x)
-2	
-1	
0	
1	
2	
3	



**Label y axis in multiples of 3.

Lesson #44 Defining Functions

A function is a relationship where one thing depends on another, and for each input or action there is **_____** output or reaction.

The easiest way to determine if a relationship is a function is to look at a

_____ or _____**.**

If the graph of the data passes the _____ then it represents a function.

To pass the vertical line test, there can only be _____(y) for each

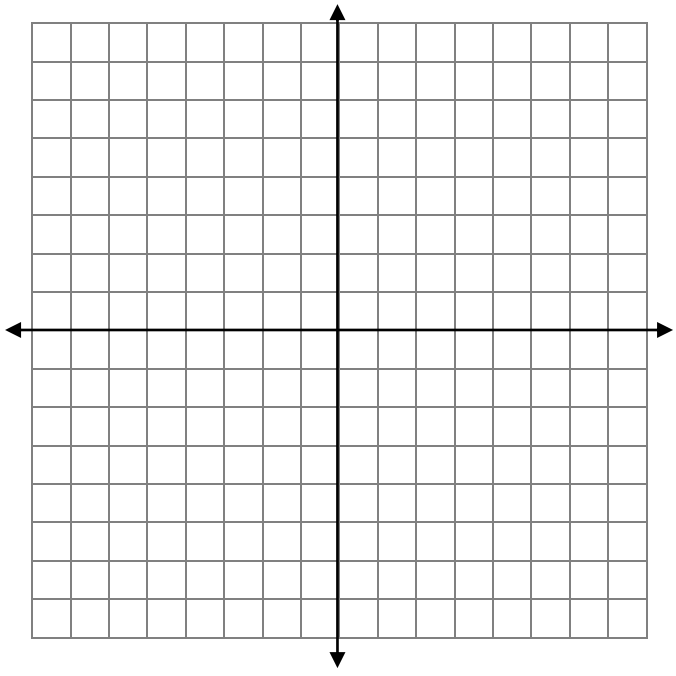
_____ (x), in other words a vertical line _____

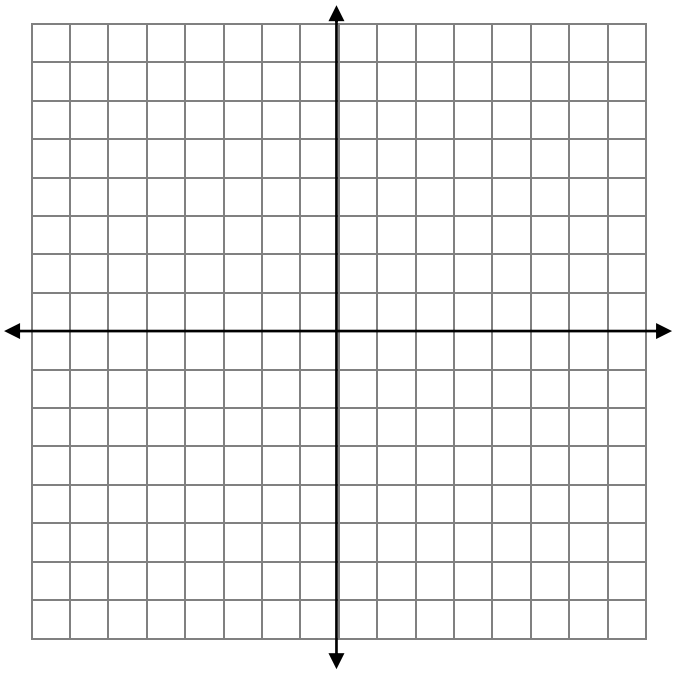
of the graph at the _____.

Graph the following sets of coordinates and explain whether they represent functions or not.

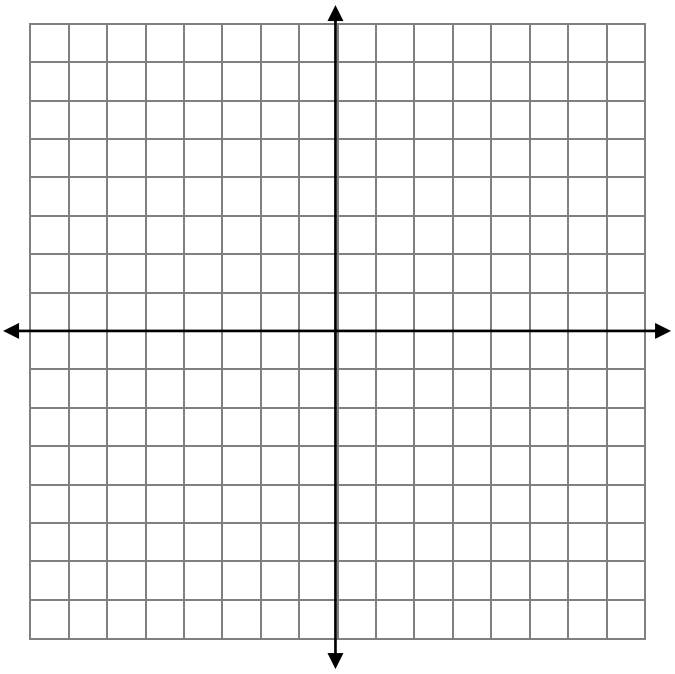
1. [(-5, 8), (-3, 4), (-1, 0), (1, -4), (3, -8)]

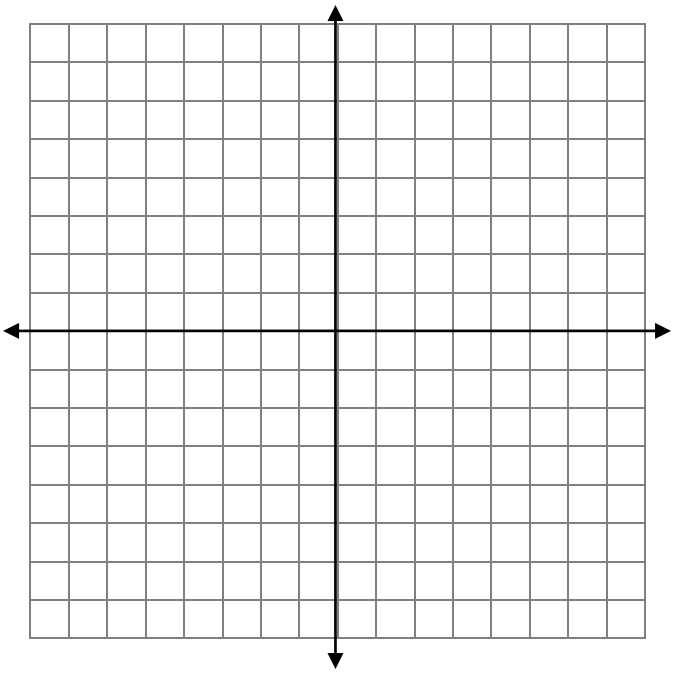
2. [(-4, -2), (-2, 0), (-2, 2), (-2, 4), (0, 6)]





3. [(-3, 5), (0, 4), (3, 3), (3, 2), (3, 1), (6, 0)] 4. [(-3, 7), (-2, 2), (-1, -1), (1, -1), (2, 2), (3, 7)]





5. Look at the coordinates that created each of the graph above, what do you notice about the one that are not functions?

6. If you are given a set of coordinates and asked if it is a function, what value cannot show up more than once?

7. Add a coordinate to the set below so that it does not represent a function.

(-3, 12), (-2, 10), (-1, 7), (0, 3) _____

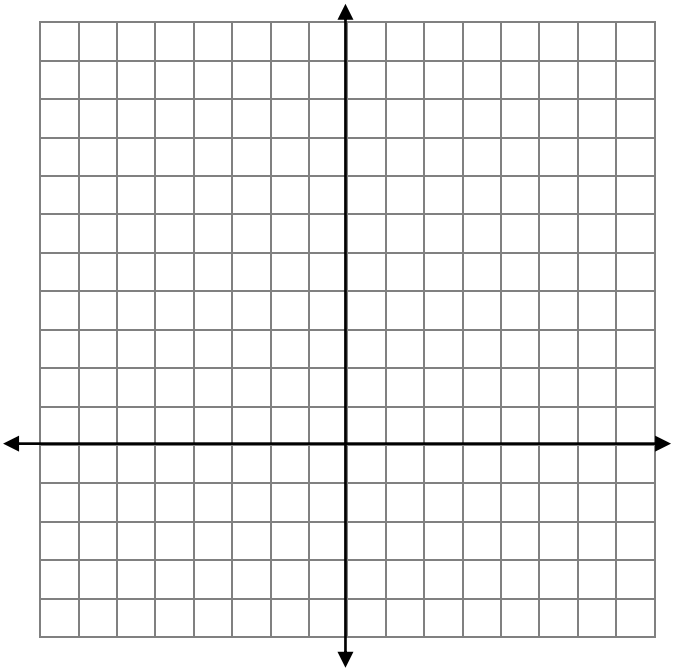
8. Eliminate a coordinate from the set below so that it does represent a function.

(1, 12), (2, 12), (3, 15), (2, 15), (4, 18)

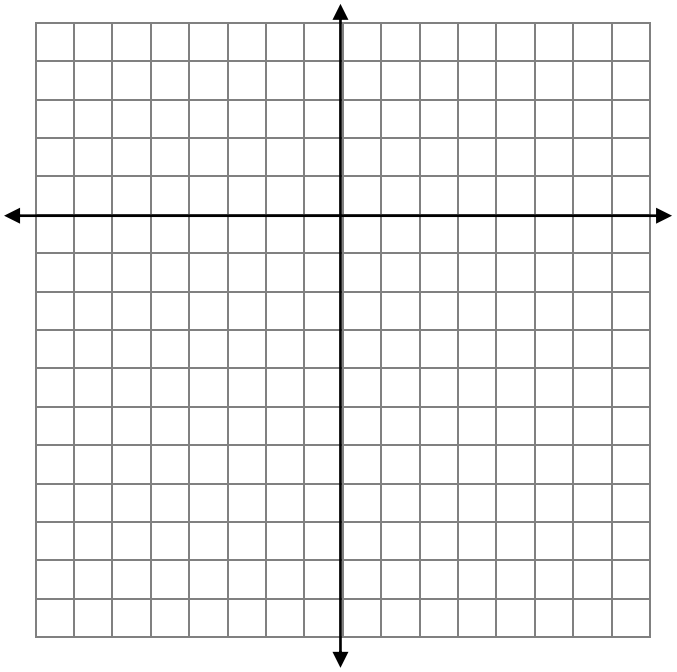
HW #44 Defining Functions

Graph the following sets of coordinates and explain whether they represent functions or not.

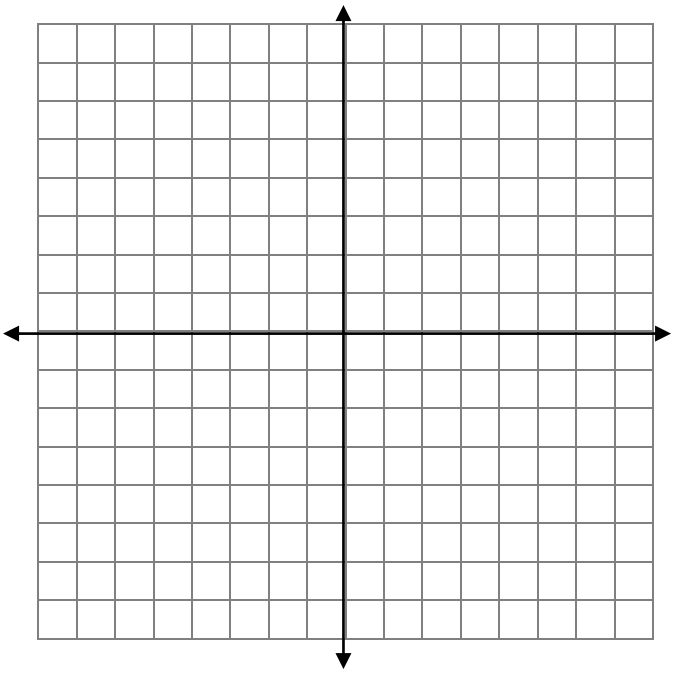
1. [(-6, 0), (-4, 4), (-2, 4), (2, 4), (4, 0)]



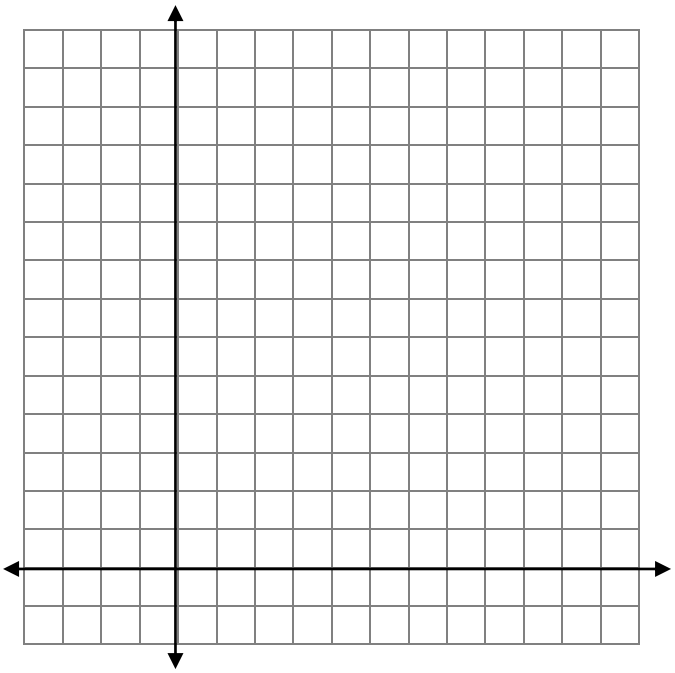
2. [(-6, -10), (-3, -6), (0, -3), (3, 0), (6, 3)]



3. [(-4, -3), (-4, 0), (-4, 3), (-2, 4), (0, 5), (2, 6)]



4. [(1, 3), (2, 7), (3, 8), (4, 7), (5, 3)]

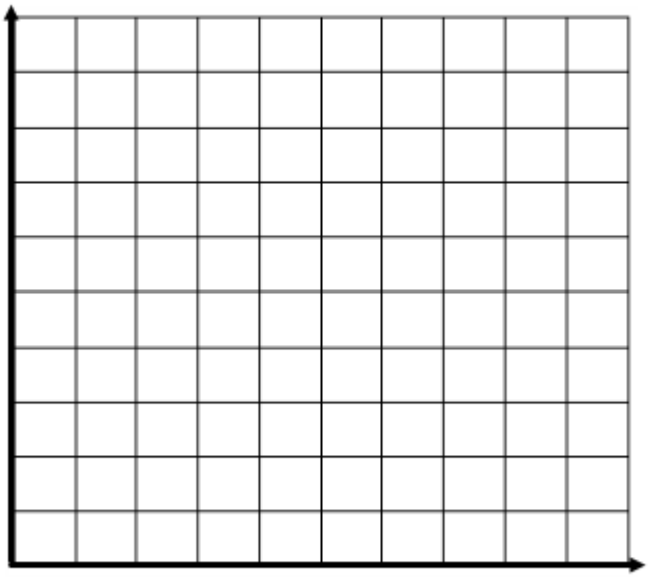


Lesson #45 A Function or Not?

With partners look at the following sets of data, graph each on the corresponding coordinate plane and then decide if it is or isn't a function.

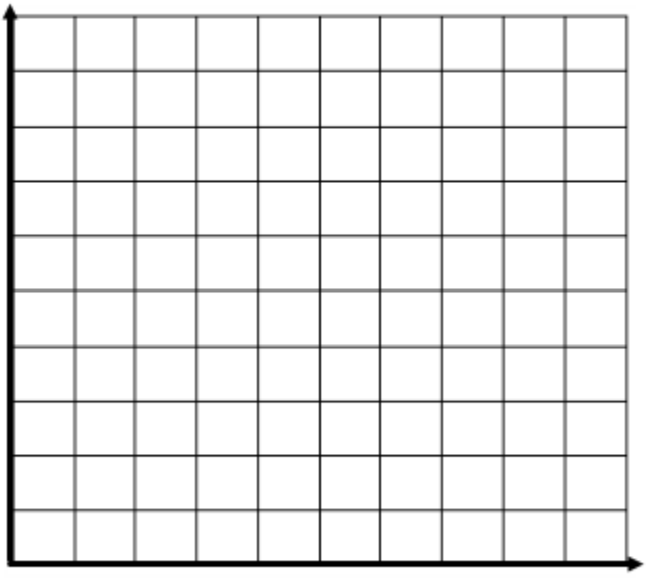
1. The temperature of the house remains unchanged over a period of 7 days, as shown in the table below. Is temperature of function of time?

Day	Temp.
Sun	68
Mon	68
Tues	68
Wed	68
Thu	68
Fri	68
Sat	68



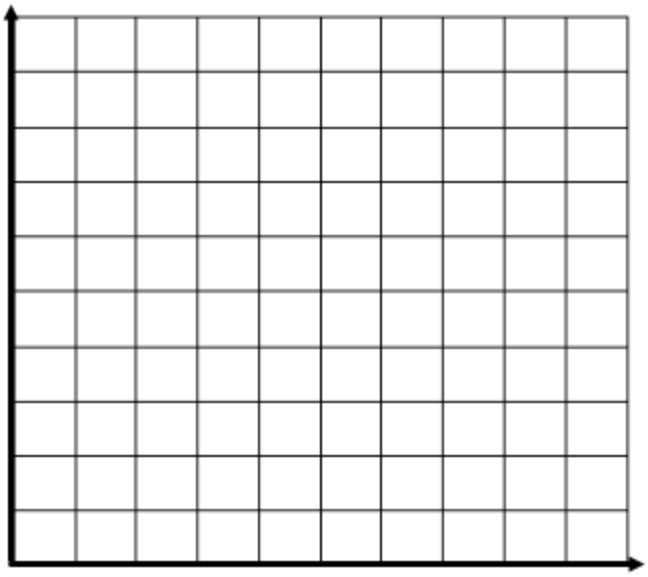
2. Ten middle school boys record their heights as shown in the table below. Is height a function of age for all teenage boys?

Age	Height
12	60"
12	68"
12	65"
13	70"
13	62"
13	64"
14	67"
14	72"
14	66"



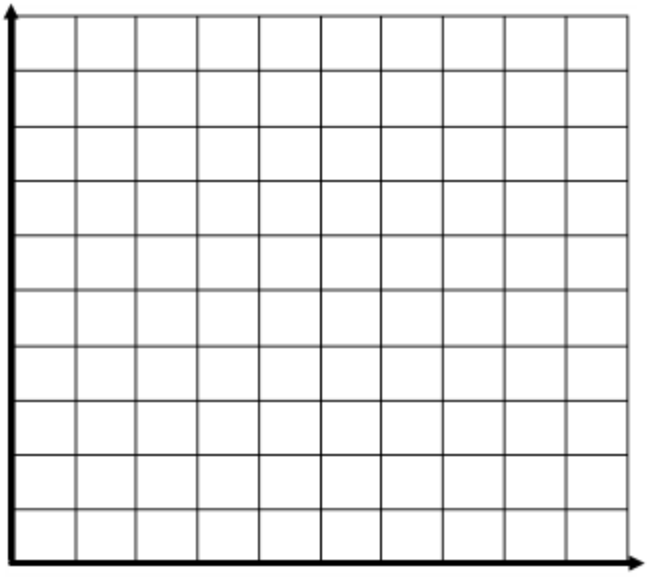
3. A t-shirt company uses the chart below to determine how to charge for any given number of t-shirts. Is price a function of how many t-shirts are purchased?

Number of Shirts	Price
1	$10
2	$18
3	$26
4	$34
5	$42
6	$50



4. A survey asks people how many people live in their house and how much they typically spend per week on groceries. The following chart shows ten responses. Is a grocery bill a function of how many people being fed?

Number of People	Grocery Bill
2	$75
2	$90
2	$120
3	$120
3	$135
4	$145
4	$150
4	$180
5	$175
5	$200

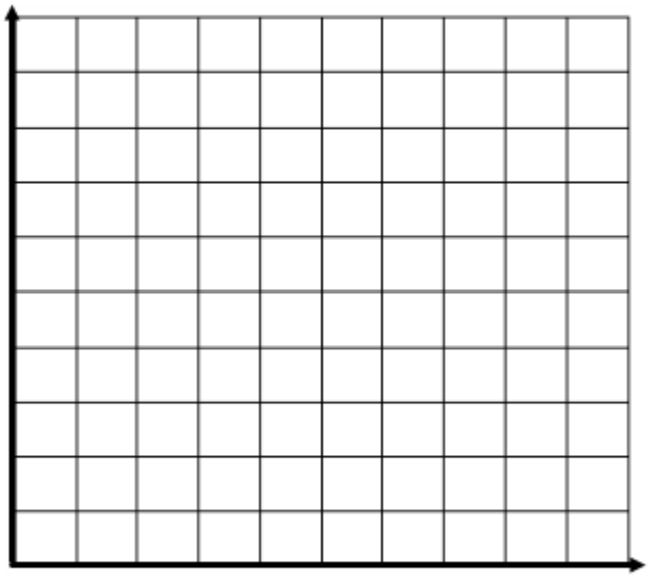


HW #45 A Function or Not?

Directions: Graph each of the following on the corresponding coordinate plane. Determine if the data represents a function, explain why or why not.

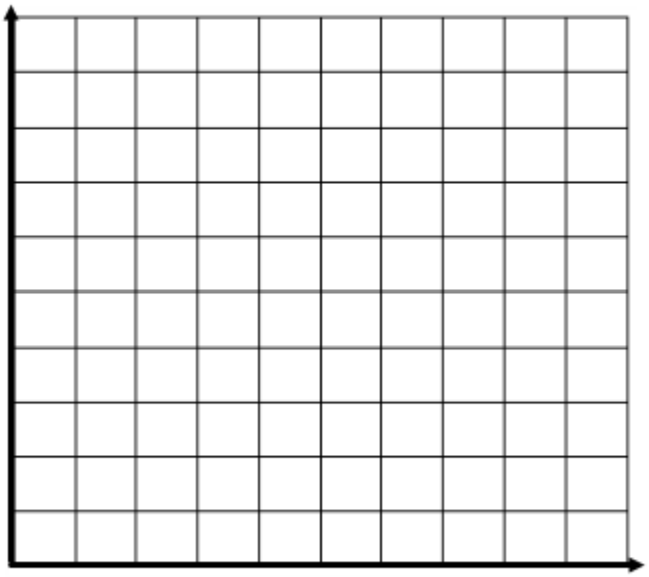
1. A car drives at a steady rate for one hour as shown in the table below.

Time	Speed
10 min	55 mph
20 min	55 mph
30 min	55 mph
40 min	55 mph
50 min	55 mph
60 min	55 mph



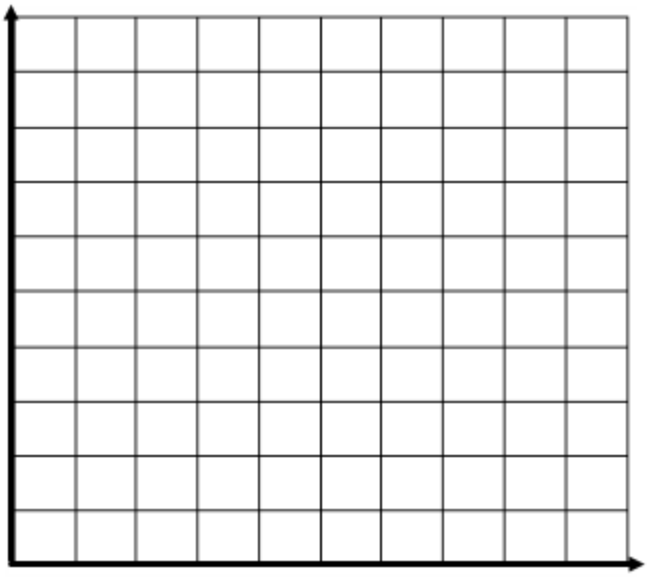
2. A teacher scores test according to the table below,

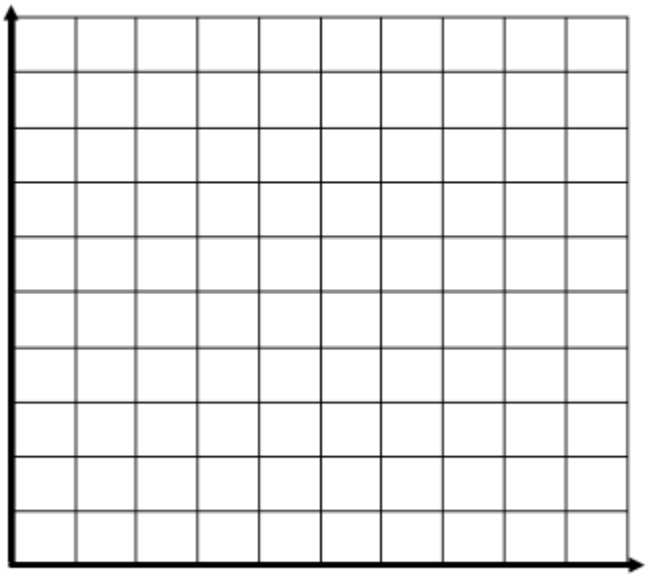
Number of Questions	Grade
0	0%
1	20%
2	40%
3	60%
4	80%
5	100%



3. The amount of money in a checking account each week.

Week	Amount of Money
1	$100
2	$48
3	$33
4	$18
5	$3



4. The hourly wage of 10 employees of different ages is reported in the chart below.

Age of Employee	Hourly Wage
18	$8.00
18	$8.00
18	$8.50
19	$8.00
19	$9.00
20	$8.50
21	$9.00
21	$9.50
22	$8.00
22	$10.00